United States Court of Appeals
for the
District of Columbia Circuit

TRANSCRIPT OF RECORD

JOINT APPENDIX

In The

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA

DAVID DALIN,
Plaintiff-Appellant,

ROBERT C. WATSON
~~JOHN A. MARZALL,~~
Commissioner of Patents,
Defendant-Appellee.

Appeal No. 11,479

United States Court of Appeals
For the
District of Columbia Circuit
FILED SEP 26 1952
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Appeal from Judgment of the
District Court for the District of Columbia

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HAMMERSMITH-KORTMEYER CO. MILWAUKEE

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JOINT APPENDIX

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FOR THE DISTRICT OF COLUMBIA

DAVID DALIN,
Plaintiff-Appellant,
v.
JOHN A. MARZALL,
Commissioner of Patents,
Defendant-Appellee.

Appeal No. 11,479

Appeal from Judgment of the
District Court for the District of Columbia

COMPLAINT FOR ISSUANCE OF PATENT

[Caption Omitted]

I.

This action arises under Revised Statutes, section 4915 (U.S.C., Title 35 § 63). No appeal has been taken herein to the United States Court of Customs and Patent Appeals.

II.

The plaintiff, David Dalin, is a subject of the King of Sweden and a resident of Stenkullen, Rönninge, in the Kingdom of Sweden.

III.

On February 19, 1946, the plaintiff, jointly with one, Tore Johannes Hedbäck, filed an application for patent in the United States Patent Office entitled "Process and Device for Destructive Distillation" which was given Serial No. 648,796. All the right, title and interest of the applicant, Tore Johannes Hedbäck, was assigned to the plaintiff, which assignment was duly recorded in the United States Patent Office on September 28, 1950, in Liber 0225, Page 136, Transfer of Patents; wherefore the plaintiff, David Dalin, is now the owner of the entire right, title and interest in and to said application Serial No. 648,796 and the invention covered thereby.

IV.

Claims 23, 24, 25, 26 and 27 of said application were finally rejected by the Primary Examiner and, on appeal taken from his decision, the Board of Appeals affirmed said decision on October 19, 1950. The defendant has refused and still refuses to grant a patent on said application as to claims Nos. 23, 24, 25, 26 and 27.

V.

The claims in issue are as follows:

> 23. In a device for the dry distillation of materials: an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation; an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft, said retort being adapted to contain material to be distilled by the heat of combustion in the shaft; and means for controlling the

temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place, said means comprising a network of ducts through which a heat absorbing fluid circulates, certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft, and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort.

24. The device for dry distillation as set forth in claim 23 wherein the heat of combustion is conducted to the material being distilled solely through the walls of the retort, and wherein said remaining ducts are mounted on the walls of said embedded portion of the retort to preclude the conducting of excessive amounts of heat through the retort walls to the material being distilled.

25. The device for dry distillation as set forth in claim 23 wherein the heat of combustion is conducted to the material being distilled solely through the walls of the retort, and wherein said remaining ducts are distributed over the walls of said embedded portion of the retort and are contiguous thereto so as to preclude excessive amounts of heat from being conducted through the retort walls to the material being distilled.

26. The device for dry distillation as set forth in claim 23 wherein said remaining ducts are carried by the walls of the retort and have surfaces exposed internally and externally of said walls.

27. The device for dry distillation set forth in claim 23 wherein said remaining ducts are mounted on the walls of the retort to reinforce the same.

Wherefore, the plaintiff prays judgment directing the Commissioner of Patents to issue to the plaintiff a patent including said claims.

IRA MILTON JONES,
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Milwaukee 2, Wisconsin
December 19, 1950

Of Counsel,
JAMES H. LITTLEPAGE,
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Washington 5, D. C.
December 19, 1950

ANSWER TO THE COMPLAINT

[Caption Omitted]

To the Honorable the Judges of the United States District Court for the District of Columbia.

I, II, III, IV, V. The defendant admits the allegations of paragraphs I to V, inclusive, of the complaint.

Further Answering, the defendant states that the plaintiff is not entitled to a patent containing any of the claims set forth in the complaint for the reasons given and in view of the references cited in the statement of the Examiner in answer to the plaintiff's appeal and in the decision of the Board of Appeals; and in view of the following additional references:

McDevitt	1,780,653
Edling	2,504,508

Profert of copies of said statement, decision, and references is hereby made.

Respectfully submitted,

E. L. REYNOLDS,
Solicitor, U. S. Patent Office,
Attorney for Defendant.

January 16, 1951

I hereby certify that a copy of the foregoing ANSWER TO THE COMPLAINT was mailed today to the attorney for plaintiff, Mr. James H. Littlepage, 832 Continental Building, Washington, D. C.

E. L. REYNOLDS,
Solicitor.

STIPULATION AS TO TESTIMONY OF WITNESSES

[Caption Omitted]

It is hereby stipulated by and between the parties to the above identified action, by their respective counsel, that were Arvid Wilhelm Johansson, Claes Joel Gejrot, Tore Johannes Hedbäck, Karl Edmund Baltzar Schjanberg and Gustaf Emanuel Edling, all subjects of the King of Sweden and residents of Sweden, called and sworn in as witnesses at the trial hereof on behalf of the plaintiff herein, they would testify as outlined hereafter; that the record shall show the following statements as though the respective parties had appeared and so testified under oath; that the exhibits referred to in the following statements as "Dalin's Exhibits Nos. 1, 2a, 2b, 3 and 4" may be received in evidence as "Dalin's Exhibits Nos. 1, 2a, 2b, 3 and 4", respectively; that any and all witnesses produced on behalf of the plaintiff at the time of trial may be examined by counsel for defendant as all matters hereinafter set forth; that Arvid Wilhelm Johansson will be called as a witness at the trial of this cause; and that objection may be made at the trial to all or any part of the stipulated testimony to the same extent and for the same reasons as if the witnesses were testifying personally:

[The stipulated testimony is omitted at this point, being reproduced in the transcript of trial proceedings.]

TRIAL PROCEEDINGS

* * * * * *

8 Mr. Jones: I will call Mr. Eugene Kohls.

Thereupon E. EUGENE KOHLS was called as a witness by and on behalf of the plaintiff and, being first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Jones

Q. Give your name, age, residence, and occupation. A. E. Eugene Kohls, 49; occupation, patent lawyer.

Q. You have been associated with me in my office for over 30 years? A. I have.

Q. What are your primary duties in my office? A. Preparation, prosecution of patent applications and general assistance in suits.

Q. Is a drafting room maintained in the office? A. It is.

Q. Is that under your direct supervision? A. It is.

Q. You have before you a chart which bears the title "Clarified illustration of application structure." Will you explain to the Court, if you will, how that chart was prepared and what it purports to show? A. The chart
was prepared in our drafting division by one of our
9 draftsmen, under my supervision, and is what I
would call a clarified illustration of the patent
drawings of the application in issue.

I might point out that the application in issue was filed directly from Sweden, that is, as it was prepared there, and consequently its drawings are not quite as clear as they might be had the application been prepared in this country and, therefore, for convenience and to afford a more easily understood illustration of the structure that is illustrated in the patent application, I had these drawings prepared, which follow the disclosure of the application, but do so in slightly better clarity.

Q. Will you briefly explain to the Court the structure shown in the drawings of this chart? A. Shown in the drawing, in all three views thereof, the structure or apparatus consists essentially of a vertical shaft, the walls of which have been colored yellow, and into which extends a vertical retort, the walls of which are colored green. The shaft is of general rectangular or square cross-section, as shown in Figure 3. The retort is rectangular in cross-section and extends from one side wall to the other. Both the shaft and retort are open at the top.

In the bottom portion of the shaft is an ash pit to receive
the ash, and you will notice, Your Honor, at the
10 extreme bottom that ash pit, especially in Figure
2, extends down into a water bath.

The grate is illustrated as four rotary hollow bars at opposite sides of the retort in Figure 1. It is that portion of the structure between the two legends, combustion air. The shale to be processed is fed into the top of the retort, which is colored green, and fills the entire retort as a vertical column.

The heat derived—let me first point out also that the coke or fuel, as we might put it, which is burned to produce, to provide the heat for the distillation process is fed into the top of the shaft at opposite sides of the retort, and Figure 2 illustrates how that coke is elevated from the bottom of the retort and then discharged into the top of the shaft.

As the process proceeds, the heat is derived from the burning coke, which is the residue left after the distillation, after the gases have been driven off from the shale by heat. That coke is discharged from the bottom portion of the retort by the screw shown in Figures 1 and 2 and then elevated to the top of the shaft, where it is deposited or dumped into the shaft to build up as a column on the grate bars and to burn and thus provide the heat
for the distillation process. Air for combustion is
11 fed into the lower portion of the combustion chamber or through the hollow grate bars and the flue gases leave the top of the shaft through the two flue outlets, illustrated in Figure 1.

In the shaft, which during the process is substantially filled with the column of coke, most of which is undergoing combustion, are a series of cooling coils that extend like fingers down into the shaft and thus will be embedded in the mass of the burning coke.

These fingers are divided into two groups, those which are embedded in the burning mass itself, and then another group, which is colored red, in direct juxtaposition to the walls of the retort, to thus bring their influence into the column.

The purpose of these coils, or more particularly the fluid heat absorbing medium, which may be water or steam-water emulsion flowing through those coils, is to control the temperature of the combustion and prevent the sintering of the coke, which would otherwise take place if that temperature were not controlled.

I think perhaps that sums up the general description of the apparatus that is involved in the application.

Q. In the left-hand column, will you explain to the Court the written matter that appears therein? A. In
the left-hand panel of this chart is the main claim,
12 No. 23, and that claim has been broken down into
its elements, paraphrased, and the respective elements' color has been applied to them to correlate them, correlate the elements of the claim with the elements of the apparatus or structure.

I might apply that claim to the apparatus which show how it reads thereon.

Q. Do so, please. A. The claim reads as follows:

> "In a device for the dry distillation of materials:
>
> "1. an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation."

That element is colored yellow in both the paraphrased illustration of the claim and in the apparatus and, obviously, constitutes or is the shaft.

The second element of the claim reads:

> "An upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft."

That element is colored green in both the illustration of the claim and the apparatus and, as I said before, extends down into the shaft and reaches almost to the bottom thereof. So, a great portion of it will be embedded in the fuel in the shaft.

13 The claim continues with the qualifying statement qualifying the second element as follows:

> "Said retort being adapted to contain material to be distilled by the heat of combustion in the shaft."

which, of course, is obvious.

The third element of the claim reads:

> "Means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place."

The claim goes on to define that means as "comprising a network of ducts through which a heat absorbing fluid circulates."

Now, I have colored that element of the claim both blue and red, the reason for which will presently appear.

The claim continues in its qualification definition of the means for controlling the temperature as follows:

> "(b) Certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft,

14 "(c) and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort."

Now, those two last qualifications or definitions of the means for controlling the temperature are the two groups of coils, one colored blue and the other colored red; the latter being directly adjacent to the walls of the retort and the former being embedded in the mass, in the body of the fuel being burned and distributed, as shown in Figure 3, in such a way that the influence of the coolant flowing through those coils reaches all portions of the burning mass and that, I understand, is vitally important for the process or for this means of controlling the temperature to function.

* * * * * *

(The chart referred to was marked Plaintiff's Exhibit No. 5 and received in evidence.)

By Mr. Jones:

Q. I have just handed you a chart which bears the
title "Bergh's bar 15 incapable of preventing sin-
15 tering." Is that a chart that was made under your
supervision in my office? A. It is.

Q. Will you please explain this chart to the Court? A. The drawing appearing in the left-hand panel of the chart entitled "Bergh's bar 15 incapable of preventing sintering" illustrated on a somewhat larger scale the lower portion of one of the figures of the Bergh patent. I believe it is Figure 1 of the Bergh patent disclosure.

* * * * * *

19 The Witness: The view or drawing in the left-
hand panel of the chart, as I believe I have indi-
20 cated before, is an enlargement of the lower portion
of Figure 1 of the Bergh patent drawing and illustrates the shaft, the vertical shaft, which is not colored but is cross-sectioned, and into which the vertical retort extends from the top and the lower portion of that retort, which is colored yellow, appears and it is space or rather in the space below the bottom of that retort is a partition wall which, on this drawing, does not bear a number but in the patent, I believe, bears the number 19.

Below that partition are the grate members, rotatable grate members, upon which the bed of ash and combustible material rests at opposite sides of that partition.

At the apex of this partition, which is rather sharply pointed, or directly above it, is that bar 15, which constitutes the crux of the controversy, as to the interpretation of the Bergh patent.

The portions that are colored red on the drawing are steam lines that lead down from a superheater coil 13 in the patent and discharge into the lower portion of the retort directly opposite and midway between the top and bottom of a circular baffle, which is colored green. The material to be distilled fills the retort and discharges from the bottom thereof into the lower portion of the
shaft at opposite sides of the partition wall and
21 combustion is maintained at the portion—it is
rather difficult without the patent to point that out because we do not illustrate that in this chart—but the material being distilled descends down through the yellow retort and then spills out down into the bottom of the shaft and at that point is burned, the combusion taking place directly at the surface of the material.

The steam which enters the lower portion of the retort does so at a level substantially in line with the bottom of a draw-off duct or tube which extends down into the middle of the retort and through which the products of distillation are drawn off.

The purpose of the steam injected at 10 from the steam inlets, which are colored red, is to establish a barrier between the distillant gases which are being drawn off or being released from the shale in the column above and the combustion gases which rise from the top of the burning bed, burning fuel.

There is one other point I would like to mention in connection with this chart, and that is as to port 28, which is located between the partition wall and directly above the grate bar. The patent refers to this port as

being an air inlet for the admission of air for combustion and/or also steam. Steam is also admitted
22 through this port 28. That steam being derived from the steam producer 12 in the patent.

* * * * * *

(The chart referred to was marked Plaintiff's Exhibit No. 6 and received in evidence.)

* * * * * *

(The file wrapper referred to was marked Plaintiff's Exhibit No. 7 and received in evidence.)

By Mr. Jones:

Q. Mr. Kohls, have you made a study of the file wrapper and contents of Bergh patent 1,618,566? A. I
23 have.

Q. Referring to the bar 15, as disclosed in the Bergh patent as issued, did the patentee during the pendency of his application indicate bar 15 as having any kind of movement; if so, explain it? A. Yes, he did. As the application was originally filed in the Patent Office, the original drawing in fact, illustrated linkage mechanism by which that bar 15 would be rocked on its axis; and the language of the specification as originally filed referred to the bar as being movable, and then by amendment those portions were deleted from the specification and also from the drawing; that is, the drawing was corrected at the inventor's request.

I believe the inventor prosecuted this application himself.

They were changed to delete, remove those portions of the mechanism which were provided to effect a rocking motion of the bars; but even in the patent as issued, in Figure 3, the bottom of Figure 3, you will notice that there are two levers that extend out to the left from the axis of the bars of the main axis of the unit there, and those—it is right at the numerals 2-A and 2-B—those levers were part of the linkage by which the bars were rocked.

Q. Will you please refer to page 15 of the certified
file, Dalin's Exhibit No. 7, and point out to the
24 Court where the drawing as originally filed in the
Bergh patent showed this linkage for rotating the
bar 15, or rocking it, rather? A. In Figure 1 of the drawing, which is reproduced as page 15 of the certified wrapper, you will notice linkage in the right-hand portion of that figure. To it numeral 23 has been applied in one instance. That linkage connects with a lever and each of the two bars, though they are not numbered, are the same as the bars 15, which is shown in the left-hand portion of the figure, and the lower end of that linkage is tied to or connected with other leverage by which the grate bars are rocked, so that by the same mechanism that was employed to rock these grate bars, it was also possible to impart an oscillating or rocking motion to the bars 15.

That linkage to which I have just referred and by which the bars 15 were rocked concomitantly with the rocking of the grate bars was deleted by amendment so that in the patent as issued that linkage does not appear.

* * * * * *

25 (The file wrapper of Edling patent No. 2,504,508 was received in evidence as Dalin Exhibit No. 8.)

* * * * * *

(The document referred to, certified copy as to title of Edling patent No. 2,504,508, was marked Dalin Exhibit No. 9 and received in evidence.)

* * * * * *

26 (Certified copy of title of application here involved, No. 648,709, marked Dalin Exhibit No. 10 and received in evidence.)

* * * * * *

Cross Examination by Mr. Cochran

Q. First, in connection with the application disclosure and the claim, you described the pipes which are colored red as in direct juxtaposition to the retort which is colored green. Now, what did you mean by that? Did you

mean they were in contact? A. Yes; in contact or sufficiently so to have the influence, that is, the heat exchange relationship, to establish a good heat exchange relationship between the interior of the retort and
27 the coolant flowing through the ducts.

Q. Showing contact in this drawing, Exhibit 5, aren't they? A. Yes.

Q. How about the application drawing itself, do they show contact in that? * * * The Witness: In Figure 1 the tubes designated 12-A on the left-hand side, at least, are shown, as nearly as I can see, in contact with the wall of the retort. Over on the right-hand side there is some space, but whether or not that is intended, I would not want to say, in view of the general sketchiness of the drawings.

By Mr. Cochran:

Q. Even on the left-hand side— A. Then again in Figure 3 of the patent drawings—

Mr. Jones: Application drawings.

The Witness: Application drawings—they are clearly in contact at both sides.

By Mr. Cochran:

Q. But in Figure 1 they are not? A. Figure 1, as I said, one side seems to be some daylight.

28 Q. On the left-hand side there is a line drawn as a section line 2 between the elements 12-A and the retort wall, is there not? A. As a section line—

The Court: He means below there?

The Witness: No.

By Mr. Cochran:

Q. There is a vertical line parallel with the retort wall, which is to indicate that a section was taken for drawing 2, Figure 2, the drawing on that line. I merely want to bring out that there is sufficient space for that line there and they are not shown in contact even on the left.

Q. Well, let the patent speak for itself on that point.

What do you think they mean by the term "juxtaposition"? It is a relative term isn't it? A. To me it means directly adjacent to or substantially contiguous.

Q. Next to? A. No.

Q. In a big machine it could be 2 inches, 6 inches, or a foot, depending on the size of the machine, the relative size of the parts; is that right? A. It is true that the term "juxtaposition", as I have used it, is not a term
that is specific and definite to the extent that direct
29 contact would be, but I don't remember whether
that is the specific language of the application in
describing that or not.

Q. The claim says "juxtaposition"; it does not say "direct juxtaposition," referring to Exhibit 5? A. Yes, the claim does say so.

Q. Referring to the analysis of the claim, as it appears on Exhibit 5, is it correct to say that the colored parts, as set forth in that analysis, are the structure elements of the claim? A. Yes.

Q. And the parts which are not colored are the definitions of functions, results to be attained? A. Except as to element 3, to which no color is applied, that is not a statement of function. That is a statement of structure. The means for controlling temperature, that is structure.

Q. What about the remainder of 3, "To preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place"—is that statement functional or not? A. That naturally is a statement of function.

Q. "Means for controlling the temperature in the
shaft," that is "means" referring generally to the
30 elements to follow? A. That is a statement of
structure which is later on more definitely defined
by the elements 3-A, B and C.

Q. It is a statement of structure in terms of function for controlling the temperatures? A. That would be all we have; but later on we go on and explain exactly what they are.

Q. In terms of structure? A. In terms of structure.

Q. So, all of the structure elements of the claim are the colored boxes; isn't that right? A. I would not agree with you, Mr. Cochran.

Q. To clarify your testimony on the Bergh drawing, as represented in Figure 6, where did you say the top of the bed of burning fuel was? A. The top of the bed of burning fuel would be, in my estimation, the angle of repose that the material would take as it issues from the bottom of the retort, and more specifically the upper portion or the surface of that angle of repose.

Q. Now, suppose this bar 15 did have a shaking movement, that would not preclude it also of a cooling function, would it? A. Naturally not, no.

Q. Is there any indication in the Bergh patent,
31 as filed, why those portions of the specifications
and drawings were deleted? A. To the best of
my recollection, there is not. I think I did state in my estimation the applicant prosecuted this claim himself and the remarks of what amendments and what changes he requested were not very illuminating.

Mr. Cochran: That is all.

Re-Direct Examination by Mr. Jones

Q. Is it not a fact that in the specification of the application here involved, that the pipes or tubes that are shown contiguous to the retort or in juxtaposition to the retort, are given the reference numeral 12-A and described as follows: "The pipes 12-A are intended to keep the temperature of the retort below a definite limit"? A. Yes.

Mr. Jones: That is all.

(Witness excused.)

Mr. Jones: I would like to call to the stand at this time Mr. Arvid Wilhelm Johansson.

If the Court please, one of the ways that Mr. Cochran and I have found out of our dilemma is have Mr. Johansson read the stipulation and that will, of course, be taken as his testimony.

32 The Court: Very well.

Whereupon ARVID WILHELM JOHANSSON, was called as a witness by and on behalf of the plaintiff, and being first duly sworn was examined and testified as follows:

Direct Examination by Mr. Jones

Q. Mr. Johansson, will you state your name? A. Arvid Wilhelm Johansson.

Q. Mr. Johansson, will you please read into the record, commencing at page 2, the bottom of the paragraph, the stipulation, which I will later probably offer in evidence?

* * * * * *

Q. Understand, Mr. Johansson, you are adopting as your testimony this part you are reading, and if you are in disagreement with any part that you read, then I wish you would not read that part but give your own testimony as well as you can remember. A. Yes.

* * * * * *

33 The Witness: Testimony of Arvid Wilhelm Johansson.

I am a resident of Kvarntorp, Sweden, and am Chief Engineer of Svenska Skifferolje A. B., Kvarntorp, Sweden. Svenska Skifferolje A. B. is a corporation, wholly owned by the Swedish Government, which operates two plants for the purpose of processing shale to recover its oil content.

I matriculated in 1927 at Halmstad, Sweden, and then entered the military service, after which I studied, 1928-1932, at the Royal Technical University, Stockholm, Sweden, where I received the degree of Civil Engineer, specializing in chemistry and chemical technology. During the years 1932 to 1934, I was employed in various factories and foundries and 1935 to 1942 served as a chemist and sulphite-engineer in the pulp and paper industry, entering the employ of Svenska Skifferolje A. B. in January, 1943. My first duties at Svenska Skifferolje A. B. were as engineer for the sulphur works at Kvarntorp and in September, 1943 I became chief engineer for the plants both at Kinne-Kleva and Kvarntorp. As chief engineer it was necessary that I familiarize myself with the entire history of
Svenska Skifferolje A. B. by a study of the com-
34 pany records and discussions with Mr. Bergh and
others having to do with the building and operation of the units in existence prior to September, 1943.

Since joining Svenska Skifferolje A.B. I have taken part in practically the whole building up of the shale oil industry and am familiar with all the known processes for extraction of oil from shale.

In 1924 the Swedish Marine Department commissioned Sven Wilhelm Bergh, patentee of Patent No. 1,618,566, to install a shale oil plant at Kinne-Kleva, Sweden, where a huge deposit of very low grade shale is located, for the purpose of processing that shale to recover its oil content. The furnace blocks of retorts of that plant were constructed substantially in accordance with the disclosure of the U. S. patent to Bergh No. 1,618,566 (hereinafter referred to as the Bergh patent). This plant had forty-two (42) individual heating chambers grouped together in three furnace block units, each containing fourteen heating chambers. Each heating chamber had the partition wall 19 of the Bergh patent dividing its zone beneath the retort 3 into two sections or chambers 9, there being a bar 15 along the upper sharp edge of the partition wall which was cooled by air.

The shale processed by the Kinne-Kleva plant had an
average oil content of four percent, and the CO_2
35 content of the flue gases discharged from the plant
was approximately four percent, indicating very
poor combustion and heat utilization. It remained in operation more or less continuously until about 1941.

Shortly after the outbreak of World War II a large plant was built by the Swedish Government at the same place, and the furnace blocks, heating chambers and retorts there employed were also substantially the same as those shown in the Bergh patent. This new plant comprised thirty-two furnace blocks or batteries like those indicated by the numeral 2 in the Bergh patent, each of which contained fourteen heating chambers 1 with five retorts 3 in each. Again, each heating chamber 1 was divided into two chambers or sections 9 by a refractory wall 19 across the top edge of which an air cooled bar 15 was positioned.

This second Kinne-Kleva plant went into operation near the beginning of 1941 and, like the first plant, processed shale of approximately four percent oil content. In an unsuccessful effort to avoid objectionable sintering, very large amounts of excess air were used to cool the fuel bed, thereby diluting the gas and bringing the percentage of CO_2 in the outgoing flue gases down to approximately four percent. No other means were ever used to attempt to correct the objectionable sintering.

36 In 1942 the Swedish Government arranged for
the installation of a large oil processing plant at Kvarntorp near Orebro where the shale was of higher grade—averaging 5½ percent oil content—than that at Kinne-Kleva. This plant comprised 32 furnace blocks using the Bergh system substantially in accordance with

the disclosure of the Bergh patent and those previously installed at Kinne-Kleva.

Because of the inefficiency of the Bergh units, in an attempt to find some means of profitably extracting the oil from the low-grade Swedish shale, other units were installed at Kvarntorp in 1942 operating on a different principle, distinguishing from the Bergh method principally in that they did not burn the residue coke but utilized an outside heat source for distillation. The coke residue of these latter two units are pyrophoric (that is, self igniting) and contained large quantities of sulphur. Consequently upon being dumped onto piles this residue ignited and soon the sulphur gas emanating therefrom destroyed vegetation for miles around and was generally destructive. Needless to say, the Swedish Government became concerned with the problem thus created and felt it must either discontinue the operation of these two units at a time when their output was greatly needed, or find some way of ridding the coke residue of its objectionable characteristics.

37 At the time when the management of the Kvarntorp plant came to the realization that something had to be done with the two units which did not burn the coke, they called upon David Dalin, managing director of AB Svenska Maskinverken, Södertälje, Sweden, and one of the coinventors of the application here in issue. This occurred in the latter part of 1943 and the beginning of 1944.

Mr. Dalin then suggested that the temperature of the burning mass be controlled by circulating a fluid heat absorbing medium in juxtaposition, but not in contact with, the fuel in the zone of combustion as broadly disclosed in U. S. patent No. 2,504,508.

A small pilot plant was then built embodying this concept at Kvarntorp. The success of that pilot unit led to the building of a small commercial plant capable of processing 150 tons of coke per day. Based on the experiences with this pilot plant Mr. Dalin in cooperation with Tore Johannes Hedbäck, his coinventor in the application in issue, further refined and improved this conception and such refinements are represented in their joint application. This took place in 1945 when the capacity of the latter plant was increased by the addition of sufficient retorts to handle 1,500 tons of coke per day, which is the total output of the non-Bergh units of the Kvarntorp plant.

38 I have carefully read and understand the Bergh patent and its Swedish counterpart No. 76,822. Based on my knowledge of the construction and operation of the Bergh units, I can say that the bar 15 of the Bergh patent in nowise controls or regulates the rate of combustion, and was never intended to so operate or function. In the Bergh patent, and the Bergh units installed at Kinne-Kleva and Kvarntorp the only means employed in an attempt to control the rate of combustion was the regulation of the volume of air introduced into the burning mass from below. This, however, was only partially successful as great difficulty was continuously experienced with sintering of the mass and a consequent loss of efficiency.

In fact, the Bergh units had not been in operation very long before it was determined that the bars 15 were a hindrance to the operation of the units and consequently they were removed. The elimination of the bars 15 in nowise increased the difficulties that were being experienced in sintering which was always a problem in the Bergh units. Even the partition walls 19 were eventually eliminated and their place taken by hollow cast iron members which served to prevent the burnt residue from falling between the rotating grate bars 20.

The sole reason for cooling the bar 15 of the
39 Bergh patent was to prevent its destruction due to
its location embedded in the hot mass below the combustion zone and entirely shut off from air. The very location of this bar supports this contention for to serve any useful purpose in controlling the burning rate

and thus preclude sintering, the bar would have to be located within the combustion zone and not below it as in the case in Bergh. Bergh's bar 15 is located well below the combustion zone and such being the case exercised no control on the rate of combustion. Therefore Bergh unsuccessfully relied upon the volume of air introduced into the burning mass from the bottom to control objectionable sintering.

In view of the success of the small 1945 commercial plant in which the rate of combustion was controlled by circulating a fluid heat absorbing medium in juxtaposition to, but not in contact with, the burning fuel, actual experiments were started in one of the furnace blocks of the Bergh installation to determine whether the principle of the instant invention could not be applied in the Bergh process to increase its capacity and improve the CO_2 content of the flue gases. In so doing the partition wall 19 (the bar 15 having been removed several years previous) was removed and cooling ducts constructed in accordance with this application were installed. This enabled the temperature in the burning coke bed to be closely controlled so that it approached the sintering temperature but did not reach it.

As stated above, the partition wall 19 and bar 15 had been removed by the management of the Kvarntorp plant because they were a continuous source of trouble, and this was before Mr. Dalin entered the picture. Removal of the bar 15 and wall 19, however, actually increased the efficiency of the Bergh units by permitting the surplus air which was introduced in an attempt to control sintering to attain a better distribution through the fuel bed.

The left hand figure on page 11 of the paper "Dalin's Exhibit No. 1" shows a Bergh unit with the bar 15 of the Bergh patent removed and the location of high-pressure steam generating coils 6 adjacent the lower end of the retort for the purpose of exercising some control over the burning of the mass in addition to the introduction of large volumes of air. These coils 6 were installed by Mr. Dalin's company over the strenuous objections of Mr. Bergh. The addition of the coils 6 (page 11, "Dalin's Exhibit No. 1") increased the efficiency of the Bergh unit as they absorbed some of the extremely excessive heat resulting from the poor control of the burning mass and put this otherwise wasted and destructive heat to good use.

Upon installation of the cooling ducts, tests were
41 immediately begun to determine their efficiency,
even before all adjustments had been made to this revamped Bergh furnace block and personnel had been trained in its operation. These tests showed that the capacity of the plant could be increased by at least two hundred percent and that the average CO_2 content of the flue gases could be increased from four percent to ten percent. These experiments were carried on for approximately six months and proved so successful that the Swedish Government ordered that Kvarntorp install means for controlling the burning rate in the zone of combustion by circulating a fluid heat absorbing medium in juxtaposition to, but not in contact with, the fuel in the zone to regulate the temperature therein as distinguished from the Bergh units and the disclosure of the Bergh patent.

The right hand figure on page 11 of the paper "Dalin's Exhibit No. 1" shows a Bergh unit as ultimately revamped to embody the concept of the Edling patent No. 2,504,508 and of the Dalin and Hedbäck application here in issue. In this form the heat absorbing medium is circulated through the coils 10 within the bed of burning coke and the coils 6 formerly about the extreme lower end of the retort were relocated at a higher point. In the unit of the Bergh patent and the left hand view, page 11 of "Dalin's Exhibit No. 1," the combustion zone
only extends to a point about three inches below
42 the surface. I have marked this figure in red ink
to show the depth to which the combustion zone extends. In the revamped unit as represented by the

right hand figure on page 11 of "Dalin's Exhibit No. 1" the combustion zone has been greatly deepened and I have marked this figure in red ink to show its extent.

The importance of this invention as regards the whole economy of the plant can be readily seen when one realizes that the extractible oil and non-condensable gas content in the shale only amounts to approximately 1100 calories per kilogram, while the heat value remaining in the coke is also approximately 1100 calories per kilogram. In other words, one-half of the total heat value of the shale remains in the coke. The utilization of this heat value in the form of power generating steam is, of course, extremely important and upon it depends the profitable operation of the plant.

The two graphs filed herewith and marked "Dalin's Exhibits 2a and 2b" illustrate the comparative results obtained in the retorts when operated in accordance with the system of the Bergh patent and when revamped so that the burning rate in the zone of combustion is controlled by circulating a heat absorbing fluid in juxtaposition to, but not in contact with, the fuel in the zone.

"Dalin's Exhibit No. 2a" shows the total oper-
43 ation result in the furnaces Bergh 2 and Bergh 3,
while "Dalin's Exhibit No. 2b" shows the operating result in the Bergh furnace rebuilt according to the Kvarntorp system.

The furnaces Bergh 2 and Bergh 3 contain together 40 blocks, each with 14 shafts according to the left picture on page 11 of "Dalin's Exhibit No. 1."

The Kvarntorp 1 furnace contains 16 blocks, each with 14 shafts, according to the right picture on page 11 of "Dalin's Exhibit No. 1."

* * * * * *

Q. Mr. Johansson, I believe you testified earlier that the Bergh units, when originally installed, had a bar 15—when I refer to 15, I am referring to the Bergh
U. S. patent—like shown in the Bergh patent; is
44 that correct? A. That was a bar, yes, sir.

Q. And the bar, which is the counterpart of bar 15 in the Bergh U. S. patent, as installed in the original Bergh unit, was water-cooled? A. Yes.

Q. What was the purpose of the cooling of the bar 15 in the original Bergh furnace? A. To prevent that bar's destruction.

Q. You testified also that the bar was later removed? A. Yes.

Q. Did the operation of the Bergh furnace increase efficiency or decrease after the removal of the bar 15? A. Increased. We could better operate when this bar was taken away.

Q. Without the bar 15 the Bergh furnace was a better operating furnace? A. Yes.

Q. Now, did the bar 15 in any wise influence or regulate the temperature of the burning mass in the combustion zone as it was mounted in the original Bergh furnace? A. No.

Q. Please refer to the showing, more particularly in Figure 1 of the Bergh U. S. patent 1,618,566, and what
have you to say as to whether the original Bergh
45 furnaces followed the construction shown in this
Bergh patent, both as to construction and as to general proportions? A. Yes.

Q. That did follow? A. That is right.

Q. So, therefore, you state that in the original Bergh furnaces the bar 15 in no wise influenced or controlled the burning in the combustion zone? A. Yes, I do.

* * * * * *

The Witness: Thus the furnaces Bergh 2 and 3 contain together 2½ times more blocks than the Kvarntorp 1 furnace and this has to be borne in mind when judging the operation results according to Exhibits Nos. 2a and 2b.

The examination of the operation results according to Exhibits 2a and 2b respectively referring to an operative period of 13 months, i.e., from December 1, 1949 to December 31, 1950, is easiest done by studying
46 the average figures in the right hand column. It is immediately found that the corresponding final operation result figures coincide rather closely in the various tables, thus indicating that the reconstruction of the Bergh furnace according to the Kvarntorp system has increased its capacity 2.5 times. The value of the production of crude gas and the high pressure steam, expressed in calories, are, however, considerably higher for the Kvarntorp 1 furnace.

A study of the figures shows that the total amount of shale processed is about the same for the combined Bergh furnaces 2 and 3 and for the single Kvarntorp 1 furnace, while the low pressure steam quantity consumed is considerably lower for the Kvarntorp 1 system. The third figure from the bottom indicates how many calories have been utilized in the form of crude oil, light petrol, crude gas and high pressure steam and the second figure from the bottom how many calories have been consumed for the processing, and consequently the proportion between the utilized calories and the supplied calories give the efficiency of the process used. This efficiency is considerably higher in the Kvarntorp 1 furnace, showing an increase from 39 percent to 59 percent.

It can thus be stated, when comparing the technical result, that the capacity of the Kvarntorp 1 furnace must have been increased more than 2.5 times, while the
47 efficiency has been increased 1.5 times. The whole process thus has a production capacity which is almost exactly four times higher, which is obtained if the proportion 50250:31500 is multiplied with 2.5.

A matter of special interest is that the steam production has been increased so that considerable quantities of electric power can be generated. Under the conditions prevailing in a furnace such as in Kvarntorp, the net electric power from Bergh 2 and Bergh 3 together is 3500 kw and from the Kvarntorp 1 oven 8100 kw, even after deducting the power consumed by the fans, conveyors, etc. for the furnaces. In other words, when Bergh 2 and 3 are rebuilt in the same manner as Kvarntorp 1, the total net electric power from these units will be increased from 3500 kw to 20,250 kw.

It is my decided opinion that the tremendous advantage of the Kvarntorp method or system over the Bergh method can be attributed primarily to the fact that Bergh's only means of controlling the rate of combustion is by introducing great volumes of air into the burning fuel bed as against circulating an indirect heat absorbing medium through the bed. Of course, the location or distribution in the fuel bed of the coils through which the heat absorbing medium is circulated has a determining effect on the efficiency of the control.

* * * * * *

48 Q. Now, referring to the Bergh patent, and I am sure Mr. Cochran will have no objection if I use this, Exhibit No. 6, as being a correct illustration of one of the Bergh retorts, will you please, using your pen or pencil, sketch into this view the type or the character of the combustion zone that was experienced in the operation of the Bergh furnace, as built according to the Bergh patent, sketch right on that chart, if you will?

The two lines that you have drawn represent the depth of the combustion zone? A. Yes.

Q. What was the position of the bar 15 with respect to the bottom of the combustion zone in the Bergh furnaces? A. That bar is located about 4 or 5 inches below that very combustion zone.

Q. The bar 15, you said, was water-cooled to prevent its own destruction; is that correct? A. That is correct.

Q. Can you explain to the Court why it is that bar 15, being 4 or 5 inches below the combustion zone, and
49 being water cooled, did not or could not exert any controlling influence on the temperature in the combustion zone? A. As I said, bar 15 is located well

below the combustion zone and the influence of the cooling medium could not be more than about half to one inch, and the difference between that point is 3 or 4 inches.

Q. By that point, Mr. Reporter, between the lower-most portion of the combustion zone and the bar 15.

Now, did you in these original Bergh furnaces, which were built in accordance with the Bergh U. S. patent, in any wise attempt to control the temperature in the combustion zone; and if so, explain how you did it? A. Yes, we did control it.

Q. And did you? A. We can we did control by three means. We can regulate the through-put of the shale.

Q. By "through-put" you mean by the rapidity or speed of shale being processed through the furnace? A. Yes; and by regulating the volume of combustion air from here (indicating).

Mr. Jones: The witness indicated to the space between the rotating grates at the lower-most portion of the view.

By Mr. Jones:

Q. Now continue with the third means. A. We can inject steam through the bar 28.

Q. In the operation of the Bergh unit, what type of product was there in the bottom of the retort below the lower-most portions of the combustion zone down to the grate through which the produce was expelled? A. That was burned coke, ash.

Q. Did any combustion take place in that area? A. No.

Q. As a matter of interest, did the retort operator at Kvarntorp continuously check the combustion zone of the furnaces? A. Yes, they did.

Q. How did he determine whether the combustion zone was too hot or not hot enough. A. They could determine that on the color of that surface.

Q. And what color existed when the zone was too hot? A. Light red.

Q. How about when the zone was not hot enough? A. Dark red.

Q. Now, the operator having examined the retort and noticed that the combustion zone was burning at too high a temperature, what would he do to correct it?
51 A. At first he would increase the through-put of the shale.

Q. That is, he would speed up the passage of shale into and through the retort? A. Slow down.

Q. He would decrease it? A. Yes.

Q. Now, he would decrease the through-put of the shale? A. Yes.

Q. Then if that failed to cut down the burning temperature, what would he do next? A. He had to increase the volume of air to get more cooling on that surface.

Q. Now, in the Kvarntorp furnaces, did they have a steam pipe equivalent to Figure 28 on the chart, Exhibit 6? A. Yes, they did.

Q. Did you use that for the introduction of steam? A. No, we never used it.

Q. Why not? A. You see, we could control the combustion by controlling the amount, the volume of air and, of course, we could have controlled this combustion by injecting steam, too, but we could not do it as good as with air and we do not want to have any waste.

52 Q. In other words, if you used the steam, whereas the air was just as good a medium, you were wasting energy? A. Yes, sir.

* * * * * *

Q. Mr. Johansson, start on page 17, the first full paragraph. A. This booklet marked "Dalin's Exhibit No. 3" for identification was prepared for the Brazil Government and at the end thereof shows a general view of the Kvarntorp plant. Many of the schematic views in this booklet are incomplete as they were intended to give only a general over-all picture. An English translation of this booklet is in preparation and when completed a copy thereof will be made available.

53 I am familiar with the structure of the Bergh patent as well as its Swedish counterpart No. 76,-822 and the commercial embodiments thereof as built and operated in Sweden.

The Bergh patent and the commercial embodiments thereof as originally installed at Kinne-Kleva and Kvarntorp had furnace blocks 2 of refractory material, each having a row of retorts 3 arranged therein. Shale to be treated was introduced into the top of the retorts and passed downwardly therethrough while being degassed, issuing from the open lower ends of the retorts directly into the combustion zone of the shaft, so that all of the combusting coke was located at or below the level of the bottom of the retorts.

The combustion area below each row of retorts was divided into two chambers 9 by means of a wall 19 along the upper edge of which was a "bar 15 which preferably is constructed hollow and provided with an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool the bar." (Bergh's patent specification, page 1, lines 82-85.) As stated above, the bars 15 were removed from the commercial installations and later the walls 19 were also removed and replaced by cast iron guards over the grate rolls 20.

As combustion proceeded, the hot gases traveled upwardly along the retorts, where their heat effected degassing of the shale in the retorts, then across steam producers and superheaters to be exhausted through stacks 27. The spent coke passed into ashpits through grate bars 20 and plates 21.

54 Air was introduced into the lower parts of the combustion chambers and the ashpit through inlets 28. As customary in the prior art devices, the amount of

air introduced tends to regulate the temperature in the combustion zone, although the patentee Bergh did not find it necessary to say so since this expedient was well known in the art. While not used in the Bergh commercial installations, the Bergh patent provides a second means of attempting to regulate the rate of combustion, i.e., the introduction of live steam, another old and well known expedient.

The only statement in the specification of the Bergh patent which in anywise appears to deal with the purpose of the bar 15 is the ambiguous sentence (page 1, lines 85-89): "The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range, which reacts upon the distilling process".

Actually, this quoted sentence must relate back to Bergh's reference in his specification to the use of steam which he injected into the combustion chamber. It is significant that the Bergh specification is silent about the regulation of the temperature of combustion, which occurs in the immediate neighborhood of the bar 15. Even more significantly Bergh's specification is also silent about the problem of sintering, notwithstanding the fact that his apparatus is expressly intended for degassing and combusting fuels having notoriously bad sintering characteristics.

To me Bergh's silence as to these features is clearly understood for in the commercial embodiments of the structure of his patent as represented by the Kinne-Kleva and Kvarntorp installations, the only control of the rate of combustion that was exercised was by the method of regulating the volume of air introduced into the burning bed and the bar 15 in nowise operated to control or influenced the rate of combustion.

In the Kinne-Kleva and Kvarntorp installations the bar 15 was installed as far as I can determine as a "fifth wheel on a wagon" for it served no useful purpose and as stated above was entirely eliminated without affecting the unit's operation, its removal being rather an improvement on the operation or at least a saving in maintenance. Being entirely surrounded by the hot mass, this bar had of necessity to be cooled to prevent its destruction. It was for this reason and no other that the bar 15 was made hollow and had water or air circulated therethrough.

The Swedish counterpart of Bergh's patent, a true translation of which is attached hereto and made a part hereof as "Dalin's Exhibit No. 4," applies the reference character 6 to the bar which is 15 in the Bergh's
56 U. S. patent. The Swedish patent says this bar "can either be fixed or given a rocking movement" and in nowise imparts to it the function of regulating the temperature of the coke residue.

* * * * * *

(Dalin's Exhibits No. 1, 2-A, 2-B, 3, and 4 were received in evidence.)

* * * * * *

57 Q. You are familiar, are you not, with Exhibit 3, which is written, I believe, in the Portuguese language? A. Yes, I am.

Q. Can you tell the Court whether the booklet which I hand you now is the same as Exhibit 3, except that it is in the English language? A. Yes, it is.

* * * * * *

58 (Dalin Exhibit No. 3-A was received in evidence.)

By Mr. Jones:

Q. Now, Mr. Johansson, earlier this morning you explained the efforts or attempts that were made in the operation of the original Bergh retort in order to control the temperature in the combustion zone. Did these Bergh units ever successfully control the temperature? A. No, it never did.

Q. When the temperature in the combustion zone reached too high a point, what happened? A. The shale or the shale coke begins to melt and will be surrounded with a glassy surface and below that surface we go to oil carbon and therefore even bad combustion.

Q. Is that what you call sintering? A. Yes.

Q. If I understand you correctly, when this sintering takes place it seals in the products of combustion within the particular piece of coke and prevents it from coming out and burning? A. Yes, that is what I mean.

Q. Does sintering cause the bed to become solid in any way? A. Yes.

59 Q. Did this happen in the Bergh original furnaces? A. Yes, it did.

Q. You described this morning the manner in which the retort operator would check on the temperature of the combustion zone. When the zone had been burning at too high a temperature did he have to do anything to break up the bed after he got it back to a satisfactory temperature? A. Yes.

Q. What did he do? A. He put in some kind of steel pokers to break it down.

Q. This morning I believe you referred to the member 28 of the Bergh patent, which is also shown on the chart as a bar? A. Yes.

Q. Did you mean to call that a bar? A. No, that is no bar. That is quite simple steam or air inlet.

Q. Referring to Dalin's Exhibit No. 1, what, if anything, did you have to do with the preparation of that paper? A. I wrote that paper, together with Tore J. Hedback, for the Fourth World Power Conference held in London.

Q. Is Mr. Hedback the coinventor with Mr. Dalin in the application here in issue? A. Yes.

60 Q. Now, referring to page 11 of Dalin's Exhibit No. 1, and the illustration or view in the left-hand side of that page, wherein red lines have been drawn as showing the combustion zone, what have you to say as to whether the person drawing that zone was

lenient in the area that he attributed to being the combustion zone? A. I did not understand your question.

Q. What have you to say as to whether the thickness, as shown by red, is larger than it normally is maintained or is it the correct size or smaller? A. This is larger.

Q. In other words, if everything was in correct proportion the combustion zone in the left-hand figure, on page 11, would not be as thick or as deep as shown here in red? A. That is right.

Q. Referring to the right-hand figure on page 11 of Dalin's Exhibit No. 1, what means, if anything, is employed to control the temperature within the combustion zone? A. We put in these tubes in the combustion zone.

Q. And the figure that you are now testifying with reference to shows a combustion zone of considerable depth. Will you explain how it is that that zone is so much deeper than the zone as shown in the left-hand
figure? A. On the left-hand figure the velocity
61 downward of the shale coke is not more than about
2 inches an hour, and in the other case about 6 inches an hour. Depending on that method—we have 2½ times more input of shale and the section is about half of the section in the original Bergh.

Q. How is it that in the structure, or modified structure, shown in the right-hand view more shale can be processed than in the original Bergh structure as shown in the left-hand view? A. We can, in the left-hand case, right-hand case, prevent any sintering.

Q. Whereas, in the left hand, which is the original Bergh, you could not prevent sintering? A. You could not prevent sintering.

Q. Do I understand you are the chief engineer in charge of the entire plant at Kvarntorp? A. Yes, I am.

Q. What have you to say as to other governments coming over to Kvarntorp to have you and your company give them information with reference to the processing of shale and possibly also process shale for them? A. Many other nations have been interested in Swedish shale or processing and many of them have asked us to make tests on foreign shales in our laboratory or in our production.

* * * * * *

64 (reading)

"Testimony of CLAES JOEL GEJROT.

"I reside at Orebro, Sweden, and am Managing Director of Svenska Skifferolje A. B., a corporation wholly owned by the Swedish Government, which operates plants for the extraction of oil from shale located at Kinne-Kleva and Kvarntorp, Sweden.

"I graduated in 1921 from the University of Technology, Stockholm, Sweden, and upon my graduation went to Germany and entered the employ of Niederdreisb. Hütte as a blast-furnace engineer. During the period 1922-1923 I was employed by Krupp, Germany, as a chemist, and during 1923-1931 I was employed as a smelting-house and open hearth engineer. 1932 to 1936 I was chief engineer for A. B Bofors, Bofors, Sweden, leaving there to become the chief engineer and technical manager of O/Y Vuoksenniska A/B, Finland, which position I held until 1941 when I became the managing director of Svenska Skifferolje A. B.

"Since receiving my degree from the University of Technology I have written several books and papers dealing with Steelwork ingots, shale and the problems connected with the extraction of the oil content, etc.

"As managing director, all of the work at the plants of Svenska Skifferolje A. B. is done under my supervision and I make it a point to closely follow all 65 of the technical problems that arise and I especially concern myself with all steps taken to increase the efficiency of the plants as due to the extremely low oil content of the Swedish shale it is difficult to process the same and not incur a loss. As the plants of Svenska Skifferolje A. B. at Kinne-Kleva and Kvarntorp are the only source of oil in all Scandinavia, their extreme importance to the Swedish economy can be readily appreciated.

"Mr. Arvid Johansson, who is giving an affidavit in the matter of the above captioned cause, is the chief engineer of the Svenska Skifferolje A. B. and he works very closely with me, the two of us being constantly in consultation as to all matters concerning the maintenance and operating of the shale plants.

"I have carefully read Mr. Johansson's affidavit being filed in this case and which, while he has approved the same, will be executed as soon as he can appear before the proper officer, and of my own personal knowledge know the contents thereof to be true. Were I to testify in this action, I would testify to the matters of Mr. Johansson's affidavit as he has stated them.

"Testimony of TORE JOHANNES HEDBACK

"I am a subject of the King of Sweden and a resident
of Södertälje, Sweden, and the Tore Johannes Hed-
66 bäck named as a joint inventor with David Dalin
of the invention in issue.

"I matriculated in 1934 at Borga, Finland, after which I entered the Technical University, Helsinki, Finland, specializing in heat and combustion technics. Upon my graduation in 1938 from the Helsinki Technical University I served my required year in the military and then was employed in the mechanical industry supervising the construction and installation of gas generators.

"In July 1941 I entered the employ of AB Svenska Maskinverken, Södertälje, Sweden, hereafter designated SMV, as a designer and calculating engineer and since March, 1947 I have been in charge of the designing department of SMV, working under Mr. David Dalin, my coinventor of the invention in issue and managing director of SMV.

"Since 1943 I have been responsible for all shipments from SMV to the Svenska Skifferolje AB plants and have personally supervised the design, installation and starting in operating of all such equipment. This has required that I spent much time at the Kinne-Kleva and Kvarntorp plants of Svenska Skifferolje AB and thus I became thoroughly familiar with their design and operation.

"In this work I cooperated closely with Mr. Arvid Wilhelm Johansson who is chief engineer of Svenska Skifferolje AB and, based on our joint experience, 67 we jointly prepared and presented the paper 'Dalin's Exhibit No. 1' before the Fourth World Power Conference held in London in 1950. I have carefully read Mr. Johansson's affidavit, dated August 11, 1951, and of my own knowledge can testify as to those facts given therein that pertain to 'Dalin's Exhibit No. 1' and as to 'Dalin's Exhibits Nos. 2a and 2b.'

"Included in those parts of 'Dalin's Exhibit No. 1' that I personally prepared is the graph appearing on page 6 thereof. This graph is the result of very extensive studies and tests made by me to determine the extent of the cooling effect of a cooling element when placed within a glowing coke bed. As shown in red on the left hand view of page 11 of 'Dalin's Exhibit No. 1' the bar 15 was located at least two inches below or outside of the combustion zone.

"While working with Mr. Dalin on the Svenska Skifferolje AB's problems, the greatest one of which was the objectionable sintering resulting from the poor control of the rate of combustion of the coke, we jointly conceived the invention of the application involved in this litigation, wherein ducts are embedded in the fuel in the shaft and others are arranged in juxtaposition to the walls of the embedded portion of the retort, a heat absorbing fluid being circulated through the ducts, the latter ducts being located in the manner of the coils 6 of the left hand view on page 11 of 'Dalin's Exhibit No. 1,' which coils I personally supervised 68 the installation of.

"In the earliest Svenska Skifferolje AB installation, Mr. Dalin and I found that due to the extreme low caloric content of the shale being processed, the coils 6 (the ones normally arranged in juxtaposition to the walls of the embedded portion of the retort) could best be raised as shown in the right hand view of page 11 of 'Dalin's Exhibit No. 1.'

"However, when shale or other material having a higher caloric content are to be processed, these coils 6 must be arranged in juxtaposition to the walls of the embedded portion of the retort as shown in the drawings forming part of the application involved in this litigation. It must be borne in mind that the caloric content of the Swedish shale only averages 2050 kg. calories per kilogram, whereas in the shale in the United States of Brazil for instance it runs as high as 4000 kg. calories per kilogram.

"I have carefully read Mr. Arvid Wilhelm Johansson's stipulated testimony and can aver as to those parts thereof bearing on matters occurring from 1943 on and particularly those portions thereof from line 4, page 7, to the end thereof, and my testimony with respect to those matters therein contained would be the same as Mr. Johansson's.

69 "Testimony of KARL EDMUND BALTZAR SCHJANBERG

"I am a subject of the King of Sweden and a resident of Orebro, Sweden, and am Chief of the Laboratory of Svenska Skifferolje AB, which position I have held since 1942, and also hold a professorship in oil-chemistry at Chalmer's University, Gothenburg, Sweden.

"I received the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy from the University of Lund, Lund, Sweden, in 1925, 1927 and 1934, respectively. During the years 1934-1939 I held the position of Assistant Professor in Chemistry at Lund University and during the years 1939-1942 I served as Assistant Professor at the University of Technology, Stockholm, Sweden. In 1942 I accepted the position of Chief of the Laboratory with Svenska Skifferolje AB, which position I still hold. At the time I accepted the position of Chief of the Svenska Skifferolje AB's Laboratory, I was appointed a full professor in oil-chemistry at Chalmer's University, Gothenburg, Sweden.

"My duties at Svenska Skifferolje AB require that I be familiar with the mechanical arrangements and processes employed in its plants, as well as their history and operation during the period preceding my connection. I am personally acquainted with Sven Wilhem Bergh, patentee of U. S. patent No. 1,618,566 and the shale processing units installed at Kinne-Kleva and
70 Kvarntorp under his supervision. In the Bergh
units as referred to in the Johansson testimony and as originally installed at Kinne-Kleva and Kvarntorp the only means employed to control the rate of combustion was the introduction of a large volume of air into the burning bed from below.

"The original Bergh units each had a bar above a partition wall dividing the combustion chamber into two zones much in the manner of the bar 15 and the wall 19 of his patent No. 1,618,566. As actually used in the Bergh units installed by Svenska Skifferolje AB, the partition wall 19 divided the burnt mass or coke residue into two streams so as to be more readily discharged through the rotating grate bars.

"A real step toward a solution of the problem arose when Svenska Maskinverken installed a coke oven at Kvarntorp of the type illustrated on page 9 of 'Dalin's Exhibit No. 1,' which involved the conception of Gustaf Emanuel Edling as covered in his patent No. 2,504,508, but was an improvement thereover. This particular structure is covered by the Dalin and Gejrot application Serial No. 581,700, allowed February 15, 1951. Svenska Maskinverken then proposed that all the Bergh units be rebuilt to provide for the circulation of a fluid heat absorbing medium through the combustion zone, 71 but not in contact with the fuel therein, as taught by the Edling patent No. 2,504,508 and the application involved in this litigation. This proposal was accepted by Svenska Skifferolje AB.

"The Bergh units rebuilt by Svenska Maskinverken and the new units built and installed by Svenska Maskinverken do not depend on air to control the burning mass and the right hand view on page 11 of 'Dalin's Exhibit No. 1' shows their construction. In the units in their present form the coils 6 are elevated to a point above the lower ends of the retorts to serve as economizers as the coils 10 are so efficient in controlling the burning rate. However, when shale having caloric value greater than that of the Swedish shale, which is extremely low, is processed, the coils 6 must be located juxtaposed to the lower end of the retort as specifically described in the Dalin and Hedbäck application.

"After the Bergh units were revamped to conform with the right hand view on page 11 of 'Dalin's Exhibit No. 1,' it was possible to process two and one half times more shale in a given time through the units than in their original form without sintering, and at the same time greatly increase the amount of useful steam generated as shown in 'Dalin's Exhibits Nos. 2a and 2b.' Thus the capital investment required to process the 72 same volume of shale as originally processed by the Bergh units was reduced 50 percent and at the same time the amount of steam available for the generation of electrical current and other useful purposes was increased. With these changes the Kvarntorp plant is rapidly becoming a source of profit.

"I have carefully read the affidavit of Arvid Wilhem Johansson, dated August 11, 1951, and particularly that portion thereof pertaining to the bar 15 and partition wall 19 as incorporated in the Kinne-Kleva and Kvarntorp installations, and of my own knowledge, I know

Mr. Johansson's statements with respect thereto are correct.

"I have also compared the statements made by Mr. Johansson in his affidavit with respect to 'Dalin's Exhibits Nos. 2a and 2b' and know them to be true, as all the laboratory tests used in compiling these exhibits were made under my supervision.

"I am also in complete accord with the statements starting with line 11, page 19, and ending in line 15, page 20, of Mr. Johansson's testimony as to the sentence in lines 85-89, page 1, of the Bergh patent specification.

"Testimony of
GUSTAF EMANUEL EDLING

"I am a subject of the King of Sweden and reside at Stockholm, Sweden.

"I matriculated in 1916 from the Junior College,
73 Linköping, Sweden, served one and one-half years
in the Military Service and in 1922 graduated from the Royal Technical University, Stockholm, Sweden. In November, 1922, I became associated with Mellersta och Norra Sveriges Angpanneförening, Stockholm, Sweden as a consulting engineer, specializing in combustion, heat and power and in 1939 I became vice president in charge of engineering, which position I have had ever since. I have under my direct charge about 115 engineers in the field of combustion, heat and power.

"In May, 1940 I was retained by the Swedish Marine Department as consulting engineer for their proposed shale oil plant at Kinne-Kleva, Sweden, particularly with regard to their combustion, heat and power problems. This plant was designed and built under Mr. Bergh's personal leadership and went into operation in the beginning of 1941 and operated all through the war. Later in about 1944 the shale oil plant at Kinne-Kleva was taken over by the new-organized government-owned Svenska Skifferolje AB, which company was then planning a new shale oil plant of greater capacity at Kvarntorp.

"I was retained by Svenska Skifferolje AB as consulting engineer in the same capacity for the new plant.

"In 1948 I was appointed as technical adviser to the Swedish Government Committee formed for the
74 purpose of finding ways and means for improving the economic results of the shale oil operations at Kvarntorp, the operation at Kinne-Kleva having been discontinued at that time. The primary reason for the appointment of the committee was the uneconomical results of the shale oil operations with the means and methods so far used. Prior to this time experiments and tests had been made under my supervision at the Kvarntorp plant based upon the principle disclosure in my patent No. 2,504,508 and certain improvements were made by Dalin, Gejrot, Hedback and Johansson. These tests indicated that if the Bergh furnaces were rebuilt according to these principles it would be possible to obtain an economical shale oil operation at Kvarntorp. A careful investigation by the committee convinced the committee that such would be the case and it was accordingly decided that one of the Bergh furnace houses, recognized as Bergh 1, later changed to Kvarntorp 1, should be rebuilt and if the results of the operation in the rebuilt plant corresponded to the contention of the committee, then the remaining two Bergh furnace houses should also be rebuilt. Should the operation of the rebuilt Bergh 1 not have been as anticipated by the committee, then I, as technical adviser to the committee, would have advised that the operation of the shale oil plant at Kvarntorp be discontinued.

"The Bergh units as installed depended upon the
75 introduction of a large amount of air into the burning mass from below to regulate or control the combustion rate thereof, and from a commercial and economical standpoint had proved impractical as the volume of shale that could be processed therein during any 24-hour period was extremely small. Also, the large

volume of air required to be passed through the burning bed, resulted in dilution of the combustion gases and a consequent loss of efficiency. Hence, the Bergh units were operated at a loss and Svenska Skifferolje AB was seeking help and advice from every quarter in an endeavor to increase the efficiency of the Bergh units.

"While making this study I conceived the idea of circulating a heat absorbing fluid through the burning bed, but not in contact therewith, thus accomplishing two results, the prevention of sintering and at the same time enabling the plant to process a greater amount of shale per hour than before, and the production of additional useful steam. This is disclosed and claimed in my U. S. patent No. 2,504,508 and the Dalin and Hedbäck application, the latter being an improvement over, but incorporating, my invention.

"I have carefully read the affidavit of Arvid Wilhem Johansson dated August 11, 1951 and the affidavit of Karl Edmund Baltzar Schjanberg, which is to be executed August 16, 1951, and of my own knowl-
76 edge can testify that all the statements contained
therein are correct."

* * * * * *

Cross Examination by Mr. Cochran

Q. Referring first to the specification of the Bergh patent, with which, I believe, you testified you are familiar? A. [Mr. Johansson] Yes.

Q. Now, I believe that you testified that a certain sentence in here referred to something other than the bar 15. The sentence reads:

"The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range, which reacts upon the distilling process."

Now, that is column 2, beginning with line 85, the first page of Bergh— A. Yes.

Q. You testified that that referred to something other than the bar 15? A. Yes, I did.

Q. Well, now, the preceding sentence: "Below the row of retorts is placed a bar 15 which preferably is constructed hollow, provided with an inlet pipe 16 and outlet pipe 17 for air or water in order to cool the bar."
77 The preceding sentence refers to the bar 15? A. Yes.

Q. And the next sentence says: "Below the bar 15 is arranged a wall," and so forth. A. Yes.

Q. There are portions of the specification both before and after that sentence which refer to the bar 15? A. Yes.

Q. What possible reason can there be for your conclusion that it refers to something other than the actual bar 15? A. I mean that that sentence—the temperature of the coke—excuse me. I mean that by regulating, by injecting steam from that part, from those steam inlets at the bottom, you possibly can regulate the combustion zone. Therefore, I mean each word about regulating refers to the bar or the steam inlet 28.

Q. We are concerned here with what Mr. Bergh intended in his specification, and since he gives a statement as to the function of something, directly after his description of the pipe 15, isn't it reasonable to suppose that he was speaking of the function of pipe 15? A. I suppose he was speaking about this bar 15; but this bar 15 could not possibly regulate the combustion zone.

Q. Then it is your testimony that the Bergh device,
78 as you used in Sweden, did not operate as stated here, as Bergh intended it? A. Yes, I mean so.

Q. Now, you included a member 15 in those machines you built in Sweden? A. We included those bars in two of our furnaces, but the third we did not include that bar; but we removed that bar 15 almost immediately because we always got sintering and when we got sintering all of the cinders hang on top of this bar. That was the first step. We removed the bar and after that we removed the partition wall, too. You see, when you have such a wall in an ash pit, the combustion intends to follow the wall and when we removed the wall we got more uniform flow from the ash pit to the combustion zone.

Q. Now, I was referring to the machines that had the bar in them. I would like to direct your attention to those specifically. Now, in those machines how large did you make the pipe 15 A. About 2 inches.

Q. What does the patent tell you about the size of it? A. Nothing.

Q. So that you just made it 2 inches because you thought that would be a convenient size? A. Yes. Bergh
himself made them 2 inches. He operated that
79 plant in Kinne-Kleva until July, 1943.

* * * * * *

Q. Now, if the pipe were bigger you would have more of a tendency to control the temperature of the bed, would you not? A. I don't think so.

Q. Why not? It would have more heat absorbing surface, wouldn't it? A. Yes, but the influence from that cooled bar to the combustion zone is very, very low because of the low conductivity in the shale, spent shale, in the coke.

Q. I believe it is the gist of your testimony that the bar 15, as it was used in the Bergh apparatus and other devices of the Bergh type, which you built, the bar 15 was not placed directly in the combustion zone where the fuel was burning? A. No, it was not.

Q. What does the patent say about that? A. Nothing about that. That bar is located below the row
80 of retorts. It says nothing about how much below.

Q. Wouldn't you say that any expert in this art would recognize that a bar which was below the combustion zone could have very little effect on regulating the temperature of the combustion zone, anyone would recognize that, wouldn't they? * * * The Witness: I would say so.

Q. So, when Bergh says that the purpose of his bar 15 is to regulate the temperature in a way which would react on the distilling process, wouldn't that indicate that he intended his bar to be placed in the combustion zone? A. He did not.

Q. He did not actually, but wouldn't this passage in the patent indicate that he intended to? A. The distillation zone is up in it, and if he had placed that bar in the combustion zone it could possibly react on the distillation.

Q. The heat for distillation comes from the
81 combustion zone, doesn't it? * * * A. That is right.

Q. If you had a cooler combustion zone bed, it would react on the distillation zone; isn't that so? A. No. The heat comes from the flue gases surrounding the retort.

Q. In other words, no amount of control that you could make down in the combustion zone would affect the temperature in the distillation chamber, the retort? A. Of course, I could affect the temperature in the combustion zone by the combustion air but only with combustion air. This bar was located below the combustion zone. This is a surface burning.

Q. That raises another question. In the Bergh specification he calls chambers 9 combustion chambers. How do you explain that? How does that conform to your idea of where the burning takes place? A. I already said that this combustion zone is not very deep and that the combustion zone is surface burning. Therefore, those chambers 9 are only ash pits and nothing else.

Q. He calls them combustion chambers, doesn't he? A. They are no combustion chambers.

82 Q. What would you say member 15 is embedded in? A. In hot ash.

Q. And it would have a cooling effect around itself for a certain distance; I believe you indicated 1 or 2 inches, at least? A. Yes; I said one-half to one inch.

Q. Was any attempt made in your experiments with the Bergh device to move the bar 15 into the combustion zone to attempt to regulate the temperature there? A. No, we never did.

Q. How did you cool the bar 15? A. With water or air.

Q. Well, which? A. With water.

Q. Do you feel, as an expert in the art, that a single bar 15 could be constructed and placed somewhat in the similar fashion as Bergh but higher, perhaps, so they would have a regulating effect on the combustion temperature? A. Yes; if he had put it in the right combustion zone.

Q. If you had done that and you had found there was not sufficient regulation, it would have been rather obvious to use a plurality of pipes rather than just one to increase your regulating effect, would it not? A. Yes, it would.

83 Q. Suppose you had before you the Bergh disclosure and the following suggestion was made: In the process of burning fuel having a low sintering temperature, the step of circulating a fluid heat absorbing medium, in juxtaposition to but not in contact with fuel in the zone of combustion in sufficient volume and quantity to maintain the temperature of the fuel in said zone below the sintering temperature thereof — if you had that suggestion with the Bergh disclosure, what changes would you make in the Bergh device? A. You see, in that case, in the original Bergh, there is a bar with cold water. In the other case, it is water with 25 atmospheric pressure.

Q. What is this other case you are referring to? A. In that case, for instance, of coke burning—I mean if you would try to put in more such bars in the combustion zone, they would be destroyed very fast because in that way he did it. He had cold water and the surface of that bar would be cold and you should get corrosion. I don't know if that was the question you asked me.

Q. Your answer did not seem to be directed particularly to what I asked you. I read you a claim.

* * * * * *

84 Q. If you had before you the Bergh patent and the suggestion contained in claim 4 of the Edling patent, what changes would that suggest to you to make in the Bergh device? A. May I ask you if you mean—I did not get the question.

Q. Would that suggest placing a series of pipes in the combustion zone in Bergh so as to regulate it so you would not get sintering? A. Not so as constructed.

Mr. Jones: He meant not the way.

The Witness: Not the way Bergh made his bars.

Mr. Cochran: I am talking about changing Bergh in the light of what Edling has to suggest in his claim.

The Court: You want to ask him how he would do it. Assuming the Bergh patent, and assuming this claim 4, this Edling patent, how would you go about doing it, making the change from the Bergh patent, in the light of No. 4? Is that what you are getting at? 85

Mr. Cochran: That is it.

The Witness: What I would do is to make a change in the Bergh patent?

The Court: By the use of No. 4?

The Witness: I would put in these tubes, embedded directly in the hot mass to get a cooling effect on the whole hot mass.

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ALEXANDER GRAHAM CHRISTIE

Q. Give your name, age, residence and occupation. A. My name is Alexander Graham Christie, age 71, a citizen of Maryland. Do you wish me to qualify?

86 Q. Yes. A. I graduated in engineering at the University of Toronto in 1901. I was employed with the Westinghouse Machine Company from 1901

to 1904 on the development work of their steam turbines and gas engines. I was instructor at Cornell University in 1904-1905, and went with the Allis-Chalmers Company in 1905 until 1907 on the development of their steam turbines and gas engines.

From 1907 to 1909 I was completing a cement mill in western Canada.

From 1909 to 1914 I was with the University of Wisconsin as assistant, and later associate professor of steam and gas engineering.

Since 1914 I have been connected with the Johns Hopkins University at Baltimore in the engineering department.

At present I am emeritus professor of that university.

I have been on a great deal of consulting work both here and abroad in connection with steam and combustion problems.

Q. Did you at my request make a study of the Bergh patent, No. 1,618,566? A. Yes, I did.

Q. Did I ask you to determine, drawing upon your wealth of experience, what effect, if any, the bar
87 15 shown in Figure 1 of the Bergh patent, could possibly have on the temperature of the combustion zone of a plant operated in accordance with the disclosure of the Bergh patent? A. It could have practically no effect.

Q. In reading the Bergh patent I note that Bergh calls the zones chambers 9; that you will find on each side of the partition wall 9, as combustion zones. What have you to say as to whether the chambers 9 support any combustion within them? A. The chambers 9 are so marked here that they are below the apex of the dividing wall 19, and if the combustion zone was below that point, the pipe 15 would have no effect whatever. If the combustion zone was, as drawn by Mr. Johansson here, just below the edge of the retort, then chambers 9 and 9 must be ash pits only.

I think there may be another point there also. By having the hot ash pass down through chamber 9, with the air coming up from below, there is a pickup of heat which would aid in combustion and it is really cooling the ash and cooling the sinter particles that he has provided that depth.

Q. Mr. Johansson on the stand this morning marked the chart, Exhibit 6, in pencil as depicting what he considered to be the area or the extent of the combustion
zone in the Bergh furnaces built and operated in
88 accordance with the Bergh United States patent.
Do you agree with Mr. Johansson in his interpretation of the extent of the combustion zone? A. As to the depth, I would think that is correct. As to the exact location, I would differ slightly, because I do not think there will be any combustion taking place in the section directly under the retort; but only this section directly under the retort has no combustion. There is no place for the gases to go and therefore there would be no combustion. The gases must pass up through the sides of the retorts so that combustion is taking place at the sides only and not directly above 15.

Q. Therefore, there is more reason than ever for the assertion that the bar 15 can have no possible control on the temperature in the combustion zone; is that correct? A. Yes, that is my conclusion.

Q. Bergh in his application says that steam is introduced into the lower end of the retort through the ports 10. What is the purpose of that steam? A. The pipe in the center of the retort is intended to draw off the gases and the volatile distilled material from the shale passing down the retort. Now there must be some suction on that pipe and in order to prevent the drawing up
of gases from the combustion zone into that pipe
89 it is necessary to seal with some steam to prevent
the entrance of the flue gases into that pipe. That was the purpose of the steam seal. That is a common experience. It is very frequently done.

Q. What means do you understand that Bergh employed in the structure of his patent 1,618,566 that could be used to in any wise control the rate of combustion or the temperature in the zone of combustion? A. Well, from my experience with gas producers, I would say that control was done by the steam admission at opening 28, because steam admitted under the fuel bed we know quite well will regulate the temperature of the fuel bed.

Q. Would the admission of air at the bottom have any effect on the combustion? A. Air also would do that, because it carries away the heat as well and keeps the temperature down.

Q. What effect, if any, would the speed of through-put of shale through the retort have? A. The slower the through-put of shale, the less combustion will take place and therefore the lower the temperature in the combustion zone.

Q. Mr. Johansson explained to the Court his reasons for considering sintering to be bad. Will you also explain to the Court why sintering is bad in an operation
90 of this type? A. Probably the easiest parallel
that I might mention is the ordinary clinker that you get in a furnace where your ash tends to run together and form a glassy surface over the surrounding material, and the hottest part of the combustion zone in this retort will be the top surface of the burning material, and therefore it will tend to flux over the dense surface and, as Mr. Johannson said, cover over some of the combustible material in the surrounding or material underneath and lessen the amount of material that may be burned out of the shale, and the tendency, once you get that sintering started, is to form a huge mass in there which is difficult to break up and for which the inventor himself provided the breaking rolls in the bottom of his device to break up his sinters.

Q. As an authority in the field of combustion, does Bergh in any wise teach you the control of the temperature in the combustion zone by other than the use of steam or air introduced through the ash pit? A. No.

Q. If you will examine the Bergh patent again, and particularly Figure 1, there is an inverted angle over each bar, is there not, so that it is of irregular shape? A. Yes.

Q. And that is shown better in the chart,
91 Exhibit 6? A. Yes.

Q. What have you to say as to whether rotation of the bar 15 would aid or assist in the breaking up of any clinkers that might form in the Bergh operation? A. In any device which tends to rock or disturb the fuel bed during its combustion tends to break up clinker or sinter formation. So that as a result the rocking of bar 15 would tend to break up and lessen the danger of the large sinters forming in the chambers.

Q. Now, referring to this angle member, which is inverted and secured over the top of the bar 15, would that angle member in any wise induce or increase the effect of the bar 15 if it had any effect on the combustion zone? A. No.

Q. If anything, it would tend to lessen any effect it might possibly have; is that correct? A. Yes. I regard it more simply as a splitter device to divide the stream of shale between the two pits 9 and 9.

Q. Now will you refer to claim 3 of the Bergh patent and the phrase that I have underlined, which reads: "Means for regulating the temperature of said coke residue." Reading that claim and referring to the Bergh disclosure, what would you, as an authority in this field,
say that Bergh had reference to? A. I would say
92 he had reference to the admission of steam and air
at port 28.

Q. How far would you say any influence of a bar such as bar 15 could extend beyond the bar? A. Not more than an inch or two. That is apparent from our usual experience in boiler furnaces where we have water-cooled walls adjacent to the burning fuel and it has an influence of only about an inch or an inch and a half or somewhere in that order.

* * * * * *

Q. I believe Mr. Johansson misunderstood a question: What effect, possible effect, can the bar 15 of the Bergh patent have on the distillation zone? A. I do not think it can have any effect whatever because the distillation zone is placed so far above the bar it would be impossible to have any influence on distillation. The material being handled here, whether coke or shale, has a very low heat transfer conductor and consequently any influence of bar 15 would be zero practically at the distillation zone, as shown in the Bergh patent.

* * * * * *

93 Q. Did you hear the question that Mr. Cochran asked Mr. Johansson with respect to what changes in structure would he make in the Bergh patent, having claim 4 of the Edling patent before him, to produce the structure that is here in issue?

* * * * * *

94 The Witness: Well, it seems to me that the Edling patent has a different idea in it from the Bergh patent. The Bergh patent, in putting bar 15 in the fuel bed, would infer that all of the arrangements that could be made in the Bergh patent, must be made in the fuel bed. In the Edling patent, the idea is introduced of cooling the retort material by having pipes along the side of the material to tend to cool the material itself in the retort, which is not involved in the Bergh patent.

95 The Court: I think we understand it was not involved in the Bergh patent. I think the question was designed to bring out how you would synthesize the two, if you could.

Mr. Jones: Maybe I can ask a question that will clear this up.

By Mr. Jones:

Q. Would the interposition of a number of tubes purely within the combustion zone or the burning combustion zone bed satisfactorily control the temperature in the distillation zone. A. Not necessarily. It could control it to some extent, but not necessarily, because the reactions in the distillation zone may themselves be heat producing which, in most cases, they are.

Mr. Jones: That is all.

Cross Examination by Mr. Cochran

Q. So, it is the gist of your testimony now that the bar 15 can have no effect on either the combustion temperature or the distillation temperature; that is correct, isn't it? A. Substantially so.

Q. Now, you base your conclusion that you drew there on the showing in the patent drawing, that is, the relative proportions, placement of the parts in the
96 patent drawings? A. Yes.

Q. You realize, of course, that patent drawings are not supposed to be scaled drawings which show exactly proportioned parts, don't you? A. Yes, sir.

Q. It is also your testimony that Bergh does not even suggest the idea of control by submerged pipe with controlling fluid in it; he does not even suggest that? A. He is putting a cooling fluid through it. He has to do that to keep the bar from being burnt up.

Q. Does he suggest control of temperatures in the furnace by that? A. He says that the temperature of the coke residue could be controlled, which we question, as to the accuracy of his statement.

Q. Now refer to claim 3. I believe it is your testimony that the "means for regulating the temperature of said coke residue" referred to means for admitting the steam or air? A. Yes. That is a very common practice. It is done all the time in the gas business.

Q. Three or four lines below that in the same claim it says: "Means for introducing air and steam in said combustion chambers." What does that refer to? A. That refers also to the admission of air and steam in 28.

97 Q. It would be kind of funny to claim the same element twice in the same claim? A. I don't know about that.

Mr. Cochran: That is all.

* * * * * *

99 (Offer of Plaintiff's Exhibit No. 11 withdrawn; Plaintiff's Exhibit No. 12 received in evidence.)

Mr. Jones: I would like to call Mr. Dalin.

Whereupon DAVID DALIN was called as a witness by and on behalf of the plaintiff, and having been first duly sworn was examined and testified as follows:

Direct Examination by Mr. Jones

Q. Give your name, age, residence and occupa-
100 tion. A. I am 59 years old. I am managing director of the A B Svenska Maskinverken. I am also president of the Sunrod Manufacturing Corporation of New York, which is a company organized to put on the American market some of our products. I have been in practical engineering for 40 years. Most of the time has been in relation to heat and boilers. Since 1941 I have been managing director of the Swedish company which I mentioned before.

Q. Are you the David Dalin who is one of the inventors in the application, Serial No. 648,796, which is here involved? A. Yes, I am.

Q. It has occurred to me, Mr. Dalin, that in our discussions here, in our questions, we have failed to bring out clearly what takes place in the distillation zone. I wonder if you would not briefly state, give us the answer. A. When the shale is brought into the retort it has a low temperature, but as it progresses downwards it is heated indirectly by the hot gases flowing on the outside of the retort.

Q. Using Exhibit No. 5, will you please explain to the Court just what part you are referring to ? A. When I talk about the retort, I mean the center part.

Q. Which is colored green? A. And the part
101 on the outside. In this particular case it is a little
different from the Bergh retort.

In this particular case it is intended to have burning fuel up above those tubes that are in this chart colored blue and red, respectively. There is, however, above this point a portion where there is no coke residue but a void space occupied by flue gases.

These flue gases are hot and they transmit heat indirectly through the retort wall into the shale that is being distilled. As the temperature rises in the shale up to about 350 to 400 degrees centigrade, the shale starts to give off its volatile content in the form of gas and this gas is taken away by suction and conveyed to various condensers and other places surrounding the plant to be used.

As the volatile contents have been driven away from the shale the other residue is what we call shale coke, which contains, in the case of Swede shale, about half of the heat content of the original shale. That residue is later burned in one way or another and supplies the heat or the majority of the heat for the continued distillation of the shale.

Q. Now, in the structure that is involved here, this de-gassed shale, which has become the shale coke, is picked up at the bottom of the retort of the chart, Ex-
hibit 5, and then by means of the screw conveyor
102 and the elevator buckets carried up and then dis-
charged into these combustion chambers that you have referred to, wherein the coke burns; is that correct? A. That is correct.

Q. Now, in the Bergh retorts, built according to his patent No. 1,618,566, in this case the burning mass of coke does not surround the retort; is that correct? A. That is correct.

Q. Are you familiar with these original Bergh retorts that were built at Kinne-Kleva and operated by Mr. Bergh? A. Very well acquainted with them.

Q. And also with the retorts at Kvarntorp? A. Yes.

Q. What, if anything, has your company had to do with the conversion of the original Bergh retorts at Kvarntorp? A. We have entirely rebuilt them, as far as the equipment for controlling the temperature is concerned, and also for all of the utilization of the waste heat.

Q. Now, in the Bergh structure, as distinguished from the structure of the application here involved, the coke proceeds down the retort much in the same manner of your application? A. That is right.

103 Q. But then when it reaches the end of the retort, when it is supposed to have been reconverted into coke shale, and there it burns in the same manner testified to by Mr. Johansson; is that correct? A. That is correct.

Q. And it is the hot gases that are given off by this burning bed passing up on the outer side of the retort that heats the retort so as to effect the freeing or distillation of the gases? A. I would say that is fundamentally so. There is also secondary heat going on down in the lower end in the form of secondary radiation from the side wall down to the retort; but the majority of the heat is transmitted from the gas direct onto the retort walls.

Q. Are you personally familiar or acquainted with the operation of the original Bergh units that were built, as Mr. Johansson testified, in accordance with the Bergh patent, No. 1,618,566? A. Yes.

Q. What have you to say as to the depth of the combustion zone in these units like the Bergh patent. A. I have not measured that myself, but some of my engineers have done very careful calculations on it.

Q. What reports did they give you as to that 104 depth of the bed? A. They told me it would be anywhere from 1 to 2½ inches.

Q. In other words, as Mr. Johansson characterized it, it was merely surface burning? A. Surface burning.

Q. These original Bergh units in Sweden that you are familiar with, did they have a bar comparable to the bar 15 of the Bergh patent? A. That I would not be able to testify to because I paid no attention to it.

Cross Examination by Mr. Cochran

Q. You say that the burning coke in the case of Bergh does not surround any portion of the retort? A. That is correct.

Q. All below it? A. It is all below it.

Q. Why is it necessary then for him to provide the protective material 18 at the bottom of the retort? A. That is partly to take care of the secondary radiation which I mentioned before. As the top of the fuel bed burns it radiates heat over to the side wall and then in turn back onto the retort.

105 Q. Well, he provides this collar on the very lowest portion? A. That is right. There is also a certain amount of heat that is conducted, transmitted from being in contact with the hot bed at the bottom, which, of course, extends up like any metal would conduct heat.

Q. Isn't it to be expected there is to be a little building up there and that is why he provided those collars 18? A. On the outside?

Q. Yes. A. No. That is impossible.

* * * * * *

(Defendant's Exhibit No. 1 was received in evidence.)

* * * * * *

106 Mr. Cochran: I meant to indicate by my opening statement that one of the primary references that we were relying upon was Bergh. That of course

was not meant to indicate that McDevitt and Parr do not have their application to certain subsidiary claims in the case. You see, Claim 23 is not the only claim involved.

The Court: If Claim 23 falls, the rest of them fall, too.

Mr. Cochran: That is right.

The Court: I think you concede that too, don't you, Mr. Jones?

Mr. Jones: Very much so, Your Honor.

* * * * * *

MEMORANDUM OF COURT

This is a proceeding brought under 35 U.S.C. Sec. 63, R.S. Sec. 4915, for a patent for a process and device for destructive distillation. The application for patent bears Serial No. 648,796.

Claims 23 to 27 inclusive of the application were finally rejected by the Patent Office and this action followed. Claim 23 is typical and is as follows:

> "23. In a device for the dry distillation of materials: an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation; an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft, said retort being adapted to contain material to be distilled by the heat of combustion in the shaft; and means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place, said means comprising a network of ducts through which a heat absorbing fluid circulates, certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft, and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort."

The rejection of the Patent Office was based primarily on the Bergh Patent No. 1,618,566, although other patents are cited to show certain ancillary features.

It seems to the Court that the claims in the pending application do not define structures which are patentably distinct from those of the Bergh patent. This being so, plaintiff would not be entitled to the relief sought. The Court is unable to say that the Patent Office was in error in its rulings.

The complaint, therefore, will be dismissed.

Counsel will prepare and submit on notice findings of fact, conclusions of law and judgment.

/s/ Walter M. Bastian,
Judge

March 18, 1952

JUDGMENT

[Caption Omitted]

This action came on to be heard at term and thereupon upon consideration thereof, it is this 31 day of March, 1952,

Adjudged that the complaint be and it is hereby dismissed, with costs against the plaintiff.

/s/ Walter M. Bastian,
Judge.

Approved as to form:

/s/ James H. Littlepage,
Attorney for Plaintiff.

FINDINGS OF FACT AND CONCLUSIONS OF LAW·

[Caption Omitted]

Findings of Fact

1. This is an action under R.S. 4915 (U.S.C. title 35, section 63) in which the plaintiff, David Dalin, sought to have the Court authorize the allowance of claims 23, 24, 25, 26 and 27 of application for patent Serial No. 648,796 of which he is assignee.

2. The application in issue relates to an apparatus for the destructive distillation of oil shale embodying a retort, in which the distillation takes place, mounted in a vertical combustion shaft, the lower end of the retort being embedded in the burning fuel bed in the combustion shaft. In order to maintain the temperature of the burning fuel below that at which sintering takes place, a number of fluid conducting cooling pipes are disposed in spaced relationship in the fuel bed, some of the pipes being disposed close to the retort wall.

3. The Bergh patent No. 1,618,566 discloses an apparatus for the destructive distillation of oil-bearing shale in which the distillation retort is mounted in a vertical combustion chamber having a combustion zone at the lower end of the retort. A network of fluid conducting pipes is disposed in the upper portion of the combustion chamber beside the retort walls, some of the pipes lying closely adjacent the walls and extending to the lower end of the retort. A further fluid conducting pipe is disposed in the coke residue below the retort.

4. The Edling patent No. 2,504,508 describes an apparatus and method for burning fuel in which the walls of the combustion chamber are cooled by, or formed of, fluid conducting pipes in order to maintain the temperature of the fuel in the combustion zone below the sintering temperature thereof.

5. The Parr et al patent No. 1,827,483 relates to an apparatus for the destructive distillation of coal wherein

heat is applied to the coal solely through the walls of a vertical retort.

6. The disposition of the lower end of the retort in the Bergh patent at the level of the burning fuel is the equivalent of embedding the lower end of the retort in the fuel.

7. The fluid conducting pipes in the Bergh combustion shaft above the combustion zone would inherently operate to control temperatures in the shaft.

8. The air or water conducting pipe embedded in the coke residue in the Bergh furnace would operate, as stated in the patent, to regulate the temperature of the fuel surrounding the pipe.

9. It would not require invention to provide the Bergh device with additional temperature controlling pipes embedded in the combustion fuel in space relation.

10. Claim 23 does not define invention over the Bergh patent disclosure.

11. The Edling patent suggests modification of the Bergh apparatus to provide a plurality of spaced cooling pipes in the combustion zone to prevent sintering of the burning fuel.

12. Claim 23 does not define invention over the Bergh patent in view of Edling.

13. Claims 24, 25, 26 and 27 define nothing inventive over claim 23.

14. Claims 23, 24, 25, 26, and 27 do not define invention over the Bergh patent in view of the prior art.

Conclusions of Law

1. Where a patent has inventors different from the applicants in a later filed application, the patent is a reference for all that it discloses against the application, even though the patent and application have a common assignee.

2. The plaintiff is not entitled to a patent containing any of claims 23, 24, 25, 26 and 27 of application Serial No. 648,796.

3. The complaint should be dismissed as to all the claims involved.

/s/ Walter M. Bastian,
Judge.

NOTICE OF APPEAL

to the

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

[Caption Omitted]

Notice is hereby given that plaintiff, David Dalin, hereby appeals to the United States Court of Appeals for the District of Columbia from the Judgment entered in this action on or about March 31, 1952.

/s/James H. Littlepage,
Investment Building,
Washington, D.C.
Attorney for Plaintiff

Of Counsel:
Ira Milton Jones
110 East Wisconsin Avenue
Milwaukee 2, Wisconsin

May 27, 1952

heat is applied to the coal solely through the walls of a vertical retort.

6. The disposition of the lower end of the retort in the Bergh patent at the level of the burning fuel is the equivalent of embedding the lower end of the retort in the fuel.

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1. Where a patent has inventors different from the applicants in a later filed application, the patent is a reference for all that it discloses against the application, even though the patent and application have a common assignee.

2. The plaintiff is not entitled to a patent containing any of claims 23, 24, 25, 26 and 27 of application Serial No. 648,796.

3. The complaint should be dismissed as to all the claims involved.

/s/ Walter M. Bastian,
Judge.

NOTICE OF APPEAL

to the

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA

[Caption Omitted]

Notice is hereby given that plaintiff, David Dalin, hereby appeals to the United States Court of Appeals for the District of Columbia from the Judgment entered in this action on or about March 31, 1952.

/s/ James H. Littlepage,
Investment Building,
Washington, D.C.
Attorney for Plaintiff

Of Counsel:
Ira Milton Jones
110 East Wisconsin Avenue
Milwaukee 2, Wisconsin

May 27, 1952

DESIGNATION OF CONTENTS OF RECORD ON APPEAL

[Caption Omitted]

To the Clerk of the above named Court:

Sir:

Plaintiff in the above entitled action hereby designates the entire record in the above entitled case as the contents of the record upon appeal, said record comprising the following papers, documents and exhibits:

(1) Complaint for issuance of patent dated December 19, 1950;

(2) Answer to the Complaint dated January 16, 1951;

(3) Stipulation as to testimony of witnesses dated October 18, 1951;

(4) Transcript of testimony of trial March 3 and 4, 1952;

(5) Memorandum of Court dated March 18, 1952;

(6) Judgment dated March 31, 1952;

(7) Findings of Fact and Conclusions of Law, filed March 31, 1952;

(8) Notice of Appeal dated May 27, 1952;

(9) This designation;

and the following exhibits:

Plaintiff's Exhibits 1, 2a, 3, 3a, 4, 5, 6, 7, 8, 9, 10, 12 (there is no Plaintiff's Exhibit 11);

Defendant's Exhibit 1.

/s/ Ira Milton Jones
110 East Wisconsin Avenue
Milwaukee 2, Wisconsin

June 5, 1952

/s/ James H. Littlepage
Investment Building
Washington, D.C.

June 6, 1952

SPECIFICATION OF DALIN ET AL APPLICATION, SERIAL No. 648,796 (As Amended)

To all whom it may concern:

Be it known that we David Dalin a subject of the King of Sweden and resident of Stenkullen, Rönninge in the Kingdon of Sweden, and Tore Johannes Hedbäck a subject of the King of Sweden and resident of Högbergsgatan 3, Södertälje in the Kingdom of Sweden, have invented certain new and useful improvements in process and device for destructive distillation of which the following is a specification reference being had therein to the accompanying drawings.

According to usual methods the destructive or dry distillation of fuels is effected in a retort to which the heat is supplied from the outside through the retort wall. In such distillation, however, it is of great importance that the heat supply to the material to be distilled, i.e. the fuel, be controlled so that the temperature is held within certain predetermined limits.

The present invention relates to a process according to which the heat supplied through the retort wall is controlled so that the temperature in the retort wall and thus also in the material to be distilled is held within predetermined limits by the provision of ducts or channels for a heat absorbing or a heat emitting medium close to or in the retort wall, dependent upon if the distillation process is endothermic or exothermic. According to the present invention the heat may be produced by combustion in a chamber surrounding the retort or by supplying heat in the ducts close to the retort.

In distilling low-grade fuels, such as shale, the distillation residue—the coke—becomes pyrophoric. Moreover, it has such a low heat value that it should preferably be combusted immediately. Therefore, the coke should preferably be combusted in a furnace as suggested e.g. in the U. S. pat. appln. serial No. 581.700. The invention may in this case be applied in such a way that the retort constructed according to the above indicated principle is located in a combustion shaft in which the distillation residues during the combustion emit the heat required for the destructive distillation. Naturally, distillation gases or fractions thereof may also be combusted in the shaft. Also other fuels than distillation residues may be used. It is also possible to use a separate combustion chamber, from which heat absorbing medium, such as flue-gases, steam, superheated steam or water, or water with steam, are led to the ducts surrounding the retort.

If a fuel shaft is used in which coke from the distillation process is combusted, the coke from the lower end of the retort may preferably be transported—immediately if the coke is pyrophoric—to the upper end of the shaft and then into the shaft.

The combustion air is admitted into this shaft preferably from below and, if the coke has a low sintering temperature, the combustion temperature is controlled by cooling the material by means of cooling medium conducted in ducts such as pipe coils arranged in the fuel bed in the way set forth e.g. in the U.S. pat. applns. Serial Nos. 563.299 and 581.700.

The retort may be made either with rectangular cross section, whereby the coke combustion shaft is divided into two compartments for example, or with circular cross section in which case a single central retort is placed in a corresponding circular shaft. It is also possible to place rectangular (possibly square) or circular retorts in a row and space them in such relation to one another as is suitable for coke combustion.

The retorts may either be cast or be made of refractory sheet iron or other suitable material. If they are made of refractory sheet iron, the cooling pipes may be encased in longitudinal sheet iron ducts which are welded on to the retort wall, said wall being thereby stiffened. Such a sheet iron stiffening offers a better cooling effect, whereby a more regular temperature is obtained in the wall of the retort.

Distillation gas is sucked out either through central pipes in the retort or through suction pipes in the top or in the bottom of the retort, the pressure in the retort being preferably held somewhat higher than the surrounding atmosphere, in order to avoid leakage of air into the retort. Yet, a slight quantity of gas will flow out through the feeding device and the discharge device respectively.

The feeding may be effected by a sluice or with a throat and magazine.

The discharge may preferably be effected with a piston and a sluice or screw.

The retort wall may be made entirely of pipes which are located close to one another and united, e.g. by welding, in such a way that they form a compact wall. The pipes may also be suitably spaced and united with one another by means of distance pieces which are of heat conducting material, said pieces being closely connected with the pipes. The retorts may also be made with double walls.

Various embodiments of a combustion chamber or furnace for carrying out the process are shown diagrammatically in the accompanying drawings, in which:

Figs. 1 and 2 are two vertical sections at right angles to one another (the latter section being taken on line II - II in Fig. 1), and Fig. 3 is a horizontal section taken on line III - III in Fig. 1 of one embodiment.

Fig. 4 is a vertical middle section and Fig. 5 is a horizontal section (the latter being taken on line V - V in Fig. 4) of a second embodiment.

Figs. 6 and 7 are horizontal sections of the combustion chamber in other embodiments. Figs. 8, 9 and 10 show details.

Figs. 11 - 15 show further embodiments.

Fig. 11 is a vertical section of a combustion chamber with retort. Fig. 12 is a partial side elevation of a retort, and Fig. 13 is a section of the latter taken on line XIII - XIII.

Fig. 14 shows another combustion chamber with retort in vertical section and Fig. 15 shows a section of the retort on line XV - XV in Fig. 14.

When not otherwise stated, similar reference characters indicate corresponding parts throughout the several views of the drawings.

The main parts of the combustion chamber according to Figs. 1 to 7 are a combustion shaft 1 preferably of brickwork and a retort 2 of sheet iron or cast iron, for example, mounted in the said shaft.

The embodiment according to Figs. 1 to 3 is first described.

The retort has a rectangular cross section and is of considerable length in proportion to its cross sectional area. The feed opening 3 is located in the top of the retort. The retort divides the coke combustion shaft into two compartments which are provided with feed devices and discharge rolls or the like, the latter being designated by 4.

The bituminous fuel, e.g. shale, is fed down into the retort by means of sluice dampers 5 located on two different levels, in order to preclude leakage of gas from the shaft during the feeding. During the distillation the fuel gradually sinks down to a discharge device, which in this embodiment consists of a screw 6 (several screws may also be used) by which the fuel is conveyed to an elevator 8. Said elevator raises the fuel to two feed chutes 9, each of which leads to its individual shaft compartment via an opening provided with a shut-off damper 10. The distilled gases are taken out at the bottom through a pipe 13*a*. In order to prevent stagnation in the retort the latter is also provided with feed rolls 4*a*. Slag and ash are removed through an opening 11 in the bottom of the shaft, said opening being between the removals held shut off by a water seal 11*a*. The combustion air is preferably fed from below.

The cooling pipe coils 12*a* and 12*b,* mentioned in the opening paragraph of the specification, serve to contain a liquid, such as water or steam or both, and constitute parts of a steam generator, for example. The pipes 12*a* are intended to keep the temperature of the retort below a definite limit. The pipes 12*b* substantially serve the same purpose relatively the fuel bed. By means of them the fuel can be held near but always below the sintering temperature. The pipes are constructed in such a way that they extend like fingers to different levels in the shaft, in order that the cooling effect shall be in suitable proportion to the combustion temperatures, see U.S. pat. appln. Serial No. 581.700. The distance of the pipes from the retort wall and from one another are suited to the heat value and the piece size of the fuel intended for the combustion chamber.

The inlet and outlet headers of the pipes are designated by 12*d* and 12*e*.

When the combustion is started, the combustion shaft is fired by means of solid fuel or oil fuel after the retort has been filled with bituminous fuel. As the lastmentioned fuel is converted into coke, the latter is discharged from the retort, is raised to the top of the furnace and is fed into the shaft by means of the device 6, 8 and 9. By this the combustion soon gets properly started and then proceeds automatically on the condition that fuel and combustion air are supplied in proper proportions and the combustion products are led off. Combustion air is admitted at 21 and the combustion gases leave through openings 22.

The embodiment illustrated in Figs. 4 and 5 has several retorts, which diverge downwardly, in order that the fuel shall fall down more easily. In the first retort from the right the gas is taken out at the top through a pipe 13*b* and in the third retort about from the middle thereof through the pipe 13*c*. The arrangement of the pipe coils is shown in Fig. 5. They have been left out in Fig. 4 for the sake of simplicity. The retorts may also extend in the transverse direction of the shaft as the retort in Fig. 3.

and Fig. 13 is a section of the latter taken on line XIII - XIII.

Fig. 14 shows another combustion chamber with retort in vertical section and Fig. 15 shows a section of the retort on line XV - XV in Fig. 14.

When not otherwise stated, similar reference characters indicate corresponding parts throughout the several views of the drawings.

The main parts of the combustion chamber according to Figs. 1 to 7 are a combustion shaft 1 preferably of brickwork and a retort 2 of sheet iron or cast iron, for example, mounted in the said shaft.

The embodiment according to Figs. 1 to 3 is first described.

The retort has a rectangular cross section and is of considerable length in proportion to its cross sectional area. The feed opening 3 is located in the top of the retort. The retort divides the coke combustion shaft into two compartments which are provided with feed devices and discharge rolls or the like, the latter being designated by 4.

The bituminous fuel, e.g. shale, is fed down into the retort by means of sluice dampers 5 located on two different levels, in order to preclude leakage of gas from the shaft during the feeding. During the distillation the fuel gradually sinks down to a discharge device, which in this embodiment consists of a screw 6 (several screws may also be used) by which the fuel is conveyed to an elevator 8. Said elevator raises the fuel to two feed chutes 9, each of which leads to its individual shaft compartment via an opening provided with a shut-off damper 10. The distilled gases are taken out at the bottom through a pipe 13*a*. In order to prevent stagnation in the retort the latter is also provided with feed rolls 4*a*. Slag and ash are removed through an opening 11 in the bottom of the shaft, said opening being between the removals held shut off by a water seal 11*a*. The combustion air is preferably fed from below.

The cooling pipe coils 12*a* and 12*b*, mentioned in the opening paragraph of the specification, serve to contain a liquid, such as water or steam or both, and constitute parts of a steam generator, for example. The pipes 12*a* are intended to keep the temperature of the retort below a definite limit. The pipes 12*b* substantially serve the same purpose relatively the fuel bed. By means of them the fuel can be held near but always below the sintering temperature. The pipes are constructed in such a way that they extend like fingers to different levels in the shaft, in order that the cooling effect shall be in suitable proportion to the combustion temperatures, see U.S. pat. appln. Serial No. 581.700. The distance of the pipes from the retort wall and from one another are suited to the heat value and the piece size of the fuel intended for the combustion chamber.

The inlet and outlet headers of the pipes are designated by 12*d* and 12*e*.

When the combustion is started, the combustion shaft is fired by means of solid fuel or oil fuel after the retort has been filled with bituminous fuel. As the lastmentioned fuel is converted into coke, the latter is discharged from the retort, is raised to the top of the furnace and is fed into the shaft by means of the device 6, 8 and 9. By this the combustion soon gets properly started and then proceeds automatically on the condition that fuel and combustion air are supplied in proper proportions and the combustion products are led off. Combustion air is admitted at 21 and the combustion gases leave through openings 22.

The embodiment illustrated in Figs. 4 and 5 has several retorts, which diverge downwardly, in order that the fuel shall fall down more easily. In the first retort from the right the gas is taken out at the top through a pipe 13*b* and in the third retort about from the middle thereof through the pipe 13*c*. The arrangement of the pipe coils is shown in Fig. 5. They have been left out in Fig. 4 for the sake of simplicity. The retorts may also extend in the transverse direction of the shaft as the retort in Fig. 3.

Fig. 6 shows a horizontal section of a combustion chamber with rectangular fuel shaft and three round retorts. In the section shown in Fig. 7 the shaft as well as the retort are round. In the two figures it will be seen how the cooling pipe coils may be located between the shaft walls and the retort walls.

As already mentioned, the wall of the retort may be made entirely of pipes for heat absorbing medium, see Fig. 8, or the retort wall itself may in some other way be provided with ducts for the medium in question, e.g. according to Fig. 9, in which 12*a* designates pipes spaced by distance pieces 12*b* so as to form a compact wall. As already indicated, the pipes may also be encased by means of longitudinal metallic members. Such an embodiment is shown in Fig. 10, in which 2 designates the retort wall, 12*a* the pipes and 18 said metal members.

As shown in Fig. 11, the retort 2 is mounted in a chamber 20 which is adapted to be traversed by hot gases from a suitable heat source. Two intakes 21 for gas burners and a gas outtake 22 are shown in the figure. The heat absorbing (cooling) medium is conducted in ducts 23 which correspond to the ducts 12*a* in the previous figures. In the figure the ducts are embodied as pipes which are helically wound around the retort. The pitch of the windings is the lowest where the heat supply is the greatest. The number of pipes may of course vary. The figure shows two pipes extending from an inlet header 12*d* to an outlet header 12*e*. The gas outtake is designated by 25.

Figs. 12 and 13 show how pipes 26 for the heat absorbing medium may be arranged in another way around the retort so that the heat absorbing surface of pipe coils with low pitch is the largest where the heat supply is the greatest.

Fig. 14 shows an embodiment with a separate combustion chamber 27, from which the flue-gases are led through heat emitting ducts 28 in the wall of the retort to a flue gas outtake 29. The heat supply can be exactly controlled by such an arrangement.

EXAMINER'S STATEMENT

This is in answer to an appeal from the final rejection of claims of the above entitled application. No claims have been allowed. The claims now on appeal read as follows:

> *Claim 23.* In a device for the dry distillation of materials: an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation; an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft, said retort being adapted to contain material to be distilled by the heat of combustion in the shaft; and means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place, said means comprising a network of ducts through which a heat absorbing fluid circulates, certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft, and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort.
>
> *Claim 24.* The device for dry distillation as set forth in claim 23 wherein the heat of combustion is conducted to the material being distilled solely through the walls of the retort, and wherein said remaining ducts are mounted on the walls of said embedded portion of the retort to preclude the conducting of excessive amounts of heat through the retort walls to the material being distilled.
>
> *Claim 25.* The device for dry distillation as set forth in claim 23 wherein the heat of combustion is conducted to the material being distilled solely through the walls of the retort, and wherein said

remaining ducts are distributed over the walls of said embedded portion of the retort and are contiguous thereto so as to preclude excessive amounts of heat from being conducted through the retort walls to the material being distilled.

Claim 26. The device for dry distillation as set forth in claim 23 wherein said remaining ducts are carried by the walls of the retort and have surfaces exposed internally and externally of said walls.

Claim 27. The device for dry distillation set forth in claim 23 wherein said remaining ducts are mounted on the walls of the retort to reinforce the same.

The references relied upon are:

Bergh	1,618,566	Feb. 22, 1927	202/106
Parr	1,827,483	Oct. 13, 1931	202/122

This application relates to a device for the destructive distillation of oil shale. As seen in figures 1, 2, and 4 the device includes a vertical carbonization retort 2 in a furnace setting 1. The material is fed into the retort 2 and heated from the outside to the distillation temperature. The distilled residue drops from the bottom of the retort while the distillation gases are withdrawn through conduits 13. As shown in figures 1, 2 the distilled residue is taken at 6 from the retort bottom and returned to the furnace setting by conveyor 8, 9, 10 to act as the fuel in the furnace setting around the retort. This fuel is burned and thereby provides the heat necessary for the distillation process. Also inside the furnace setting are cooling ducts such as members 12 as shown in the various figures on the drawing. These cooling members act to prevent sintering and to permit a rapid and efficient complete combustion of the carbonaceous material in the residue.

Prior Art

The Bergh patent is the principle reference. This patent device shows a similar structure for carbonizing oil shale. There is a furnace setting 2 containing heating chambers 1. Inside the heating chambers are retorts 3. The shale is charged into the retorts 3 and is there heated to carbonization temperatures and is destructively distilled. The residual material drops out of the bottom of the retort into a combustion chamber while the eduction gases are withdrawn through conduit 6. The residual material is burned in the combustion chamber beneath the retort to provide the heat for the carbonization process. The ash is discharged from the heating chamber through grates 20, 21. Inside the heating chamber there are cooling members 12 and 13 around the upper part of the retort 3 and additional cooling members 15, 28 embedded in the material undergoing combustion. Member 10 feeds steam into the bottom of the retort to prevent any admixture and dilution of product gases with combustion gases coming through the open bottom of the retort.

According to page 18 of paper 9 in copending application 581,700 to which paper applicant makes reference in the last amendment, the Bergh patent device has been in extensive operation for over 25 years.

The Parr patent 1,827,483 is cited to show in figure 5, 8 a conventional vertical retort setting where the material retorts 44 are heated solely by heat transfer through the retort walls from furnace setting 45, 49 and burners 47.

Rejection

Claim 23 is rejected on Bergh 1,618,566. The reference shows an upright combustion chamber 1; and an upright retort therein. It would appear that under the normal operation of the unit the lower portion of the retort at member 18 would be embedded in the fuel. Further, in so far as defined, this limitation does not appear material. No difference in operation or results are apparent in embedding the retort bottom in the fuel bed. The claim further recites that the temperature control means comprise ducts in the fuel bed transversely of the shaft and other ducts in juxtaposition to the walls of said embedded portion of the shaft. The reference patent shows cooling duct 15 in juxtaposition to the embedded portion of the retort and duct 28 positioned transversely of the retort which may be used to introduce steam. There are also cooling duct members 12 and 13 outside the combustion zone which would indirectly tend to control the combustion. The use of a "network of ducts" is considered as merely duplicating these embedded members. The preferred number and placement of cooling ducts in the furnace setting would appear within the expected knowledge of a man skilled in the art.

It is noteworthy that the claims now being prosecuted do not read on several figures of the drawing. These figures show, as in Figure 14, the solids being combusted in a separate chamber and, as in figure 11, the flue gases heat the retort. These modifications as well as those on which the claims are readable had all been presented as several ramifications of applicant's invention.

Claims 26 and 27 are also rejected as unpatentable over Bergh as applied against claim 23. The specific placement of ducts either in the retort wall or carried by the retort wall are considered as immaterial details, which would be obvious expedients to a man skilled in the art.

Claims 24, and 25 are also rejected as unpatentable over Bergh as applied against claim 23 either alone or in view of Parr 1,827,483. The details of the duct placement "mounted on the walls of the embedded portion of the retort" or "distributed over the walls of said embedded portion of the retort" are considered as obvious expedients and as immaterial changes in position. The recitation that the heat is conducted solely through the walls of the retort is not considered to be a patentable variation from the Bergh patent. No advantages are apparent in this limitation on heat flow. In the Bergh patent device some heat might be introduced with the steam at 10 or by direct travel through the open bottom of the retort. However, this feature of heat flow solely through the retort walls is old in the art as shown by the Parr patent. No invention would be involved in view of Parr in preventing any additional heat from entering with the steam or through the retort bottom.

Respectfully submitted,

Examiner.

EXAMINER'S REPLY TO BRIEF

On pages 8-10, 31, and 32 of the Brief, applicants appear to argue that this application should be allowed for the same reasons that the Board of Appeals allowed certain claims of the patent to Edling 2,504,508, granted April 18, 1950 (subsequent to the Examiner's Statement) on an application filed *in this country,* Nov. 13, 1944 (prior to applicant's filing date *in Sweden*). It seems manifest that applicants' claims cannot be allowed on this basis. Contrary to applicants' statement on page 8 of their Brief, this patent insofar as it relates to applicants' invention *is a reference against applicants for its entire disclosure.* In re Beck et al 1946 C. D. 278. Moreover, the present application has different claims rejected on different references from those cited in the Edling case.

On pages 11 through 19 of the Brief, applicants give a lengthy account of the alleged history of their experience with the apparatus shown in the Bergh patent. There is no proof whatever of these alleged facts in the record and the Examiner has no knowledge concerning their accuracy.

On pages 3, 4, and 29 through 40, applicants discuss at length numerous patents other than the Bergh and Parr patents relied on in this appeal. Such discussion does not appear to be pertinent to the issues on appeal.

On pages 24 and 25 applicants discuss the amendments made in the Bergh application prior to its issue. Since the Bergh patent issued in 1927, nearly twenty years before applicants' filing date, the previous amendments appear immaterial. The patent specification as actually worded (page 1, lines 81-89) seems to clearly indicate that the function of the cooling means for bar 15 is to "control the temperature of the coke residue in the lower part of the retort".

Applicants discuss on pages 40 and 41, the bearing of the Parr patent on the *problem of sintering.* This patent, however, was cited as an illustration of the destructive distillation of solids *solely by heat conducted* *thru retort walls* (See Examiner's Statement, pages 4 and 6).

On page 42 of the Brief, applicants predicate the patentability of their claims in so positioning the heat exchange pipes in the fuel bed as to avoid sintering.

However, in the specification, page 3, second complete paragraph, two prior applications are acknowledged as showing this feature. Application Serial Number 563,299, there acknowledged, has matured into the Edling patent previously referred to. Application Serial Number 581,700 is a joint application of David Dalin, one of the joint applicants in the present case, and one C. J. Gejrot. It is now pending in Div. 46.

This passage is the only mention of sintering found in the entire specification.

At no point in the 43 page Brief do applicants discuss the appealed claims in any detail or point out what structure recited therein is critical for attaining the now-professed object of preventing sintering. In view of the large number of modifications disclosed in this case on which the claims now on appeal do not read, there appears to be no reason to consider the claimed structure as critical.

Respectfully submitted.

Examiner

DECISION OF BOARD OF APPEALS

This is an appeal from the action of the Examiner finally rejecting claims 23 to 27, inclusive, all of the claims in the case.

Claims 23 and 24 are reproduced as exemplary:

> 23. In a device for the dry distillation of materials: an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation; an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft, said retort being adapted to contain material to be distilled by the heat of combustion in the shaft; and means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place, said means comprising a network of ducts through which a heat absorbing fluid circulates, certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft, and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort.
>
> 24. The device for dry distillation as set forth in claim 23 wherein the heat of combustion is conducted to the material being distilled solely through the walls of the retort, and wherein said remaining ducts are mounted on the walls of said embedded portion of the retort to preclude the conducting of excessive amounts of heat through the retort walls to the material being distilled.

The references relied on are:

Bergh	1,618,566	Feb. 22, 1927
Parr et al	1,827,483	Oct. 13, 1931

The appealed claims relate to a furnace or retort for the destructive distillation of oil shales and similar materials. The furnace comprises a central shaft constituting a retort, surrounded by a combustion space wherein the coked or carbonized material is burned to furnish heat for the destructive distillation of the material within the central shaft.

The claims have been rejected as unpatentable over the patent to Bergh. The patent to Parr et al is relied on to show certain ancillary features which will be hereinafter discussed.

Bergh describes a similar type of retort for the same purpose, that is, the destructive distillation of oil shales utilizing the residual coked material as a fuel. Claim 23 purports to differ from the Bergh reference in the requirement for a means for controlling the temperature, said means comprising a network of ducts. The Examiner refers to the bank of tubes 12 in Bergh constituting a boiler, the superheater tubes 13 placed alongside the retort wall and the hollow bar 15 as constituting the ducts required in claim 23. In the arrangement shown in Bergh steam is formed from the water in the bank of tubes 12 and that steam is superheated in the tube 13 and then injected into the retort at 10 where it is used to supply some of the heat for distillation. There is some controversy as to the functions of bar 15. We reproduce the critical statements of the patentee concerning this feature:

> "Below the row of retorts is placed a bar 15, which preferably is constructed hollow and provided with an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool the bar. The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range which reacts upon the distilling process."

Appellants contend that the bar is cooled only to prevent its being burned and that it serves no useful function in cooling the combustion zone or in controlling the rate of combustion so as to prevent sintering or the formation of clinkers. The quoted matter indicates that the temperature of the burning fuel is regulated to some extent by the hollow bar 15 and that this in turn reflects some control of the distillation temperature. While the bank of tubes 12 and the tube 13 are described by the patentee primarily as constituting a waste heat boiler, it is inevitable that in the operation of the Bergh furnace the temperature both within and without the retort will be lowered and controlled by the presence of these ducts as well as the duct 15, since heat absorbing fluid is circulated through all of them, and since such ducts are either in contact with the burning fuel or the products of combustion thereof.

Appellants have discussed at some length the intended functions and procedure to be employed in using the claimed structure and also has discussed in detail the history of development of the art of recovering oil from oil shales. We do not find these matters pertinent to a consideration of the questions here on appeal, which is whether or not the claims define structures which are patentably distinct from the structures of the references. It seems impossible to reach any other conclusion than that the bank of tubes 12, the tube 13 and the hollow bar 15 of Bergh constitute a network of ducts through which a heat absorbing fluid may be circulated and that such ducts constitute a means for controlling the temperature. One of these ducts, that is, 15 is embedded in the fuel. We agree with the Examiner that no invention would be involved in duplicating the bar 15 where a greater degree of regulation of the temperatures of the coke residue is desired.

The question of whether or not invention is involved in a procedure which avoids sintering the coke residue is not of significance from the standpoint of the claims to the structure here in consideration.

Claim 24 is dependent on claim 23 and adds the limitation that heat of combustion is transferred to the retort only by conduction through the walls thereof. This excludes the injection of superheated steam as contemplated by Bergh. Heating the contents of a retort solely by conduction through the walls thereof is an old expedient as shown in Parr et al, and in view of that patent, we agree with the Examiner that no invention would be involved in modifying the structure of Bergh so as to exclude the injection of steam into the retort.

Claim 24 also refers to mounting some of the ducts on the walls of the retort. It is not clear from Bergh whether the superheater tubes 13 are completely supported by the walls of the retort or partially independent thereof. This is a structural detail that is held to be without significance from the standpoint of patentability.

Claims 25, 26 and 27 are likewise dependent on claim 23 and refer to the distribution of the ducts, other than those through the fuel bed, as supported on the walls of the retort or carried by the external walls of the furnace. These structural details, like those referred to in connection with claim 24, are not of significance from the standpoint of patentable merit.

The decision of the Examiner is affirmed.

In event of appeal attention is directed to *In re Boyce,* 32 C.C.P.A. 718; 144 Fed. (2d) 896; 1944 C.D. 609; 568 O.G. 568; 63 U.S.P.Q. 80, in regard to specifically including in the appeal notice all grounds of rejection in the Examiner's Statement not expressly overruled by the Board.

F. J. Porter
Examiner-in-Chief

E. F. Klinge
Examiner-in-Chief

E. W. Geniesse
Examiner-in-Chief

BOARD
OF
APPEALS

October 19, 1950

Feb. 22, 1927. **1,618,566**

S. V. BERGH

FURNACE AND APPARATUS FOR UTILIZING SHALE OR OTHER BITUMINOUS MATERIALS

Filed Sept. 25, 1923

Fig. 1.

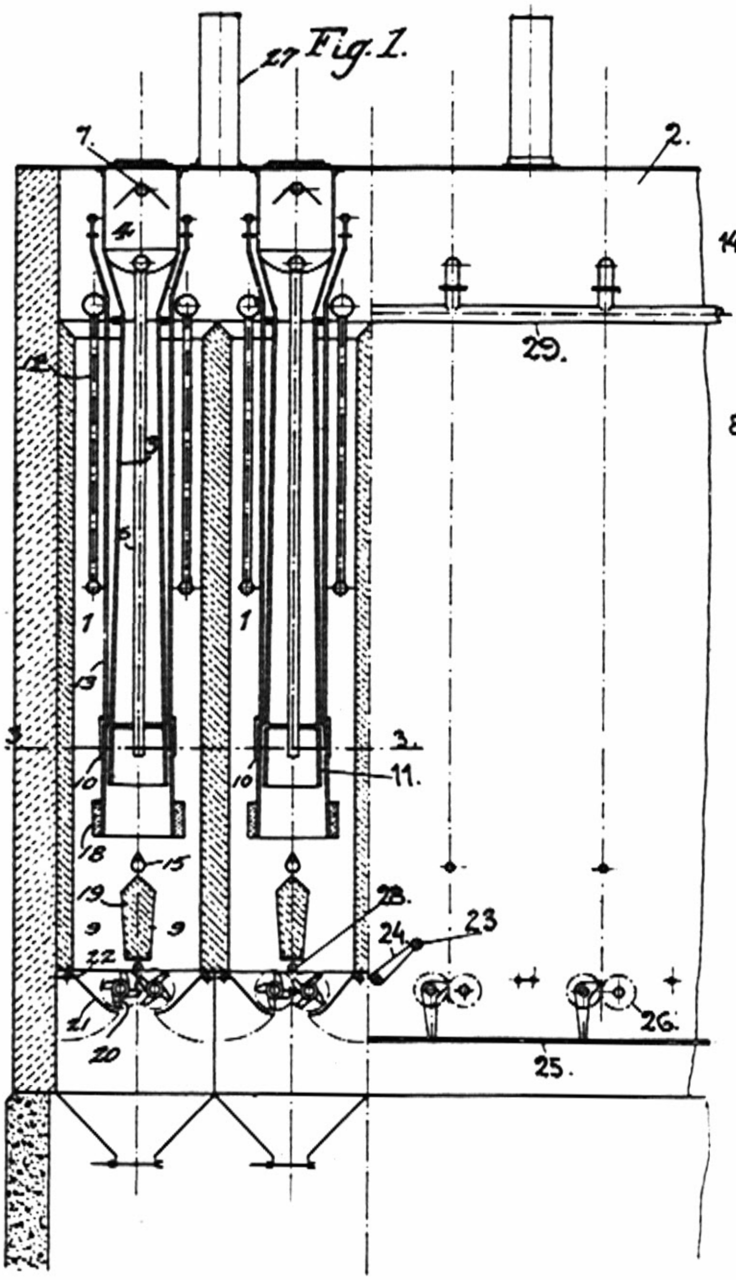
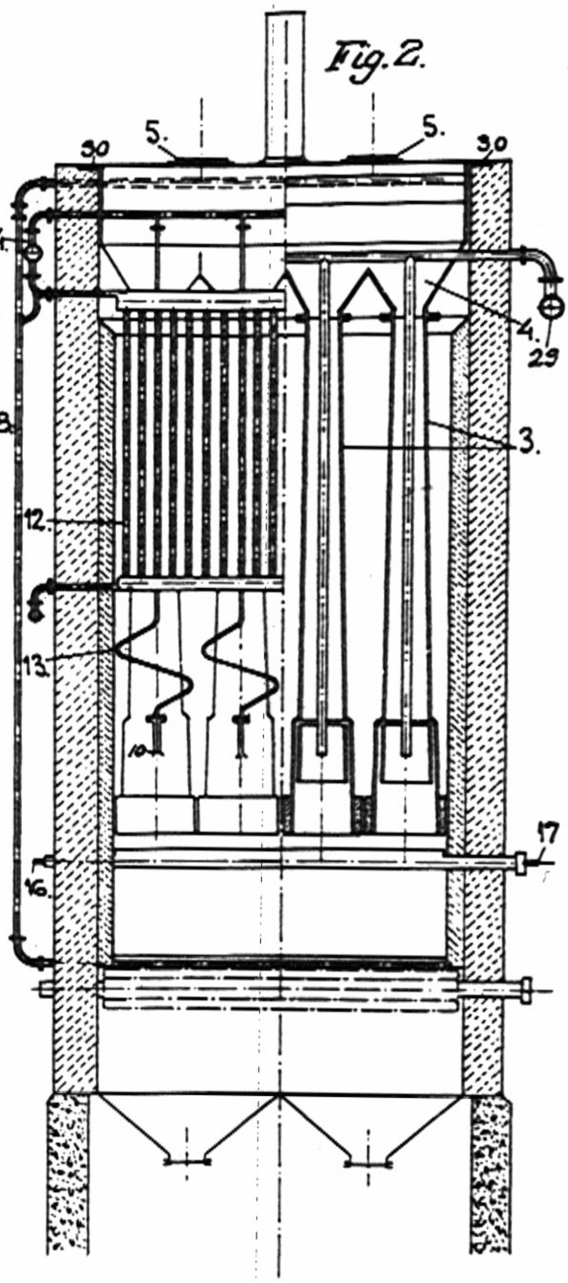


Fig. 2.



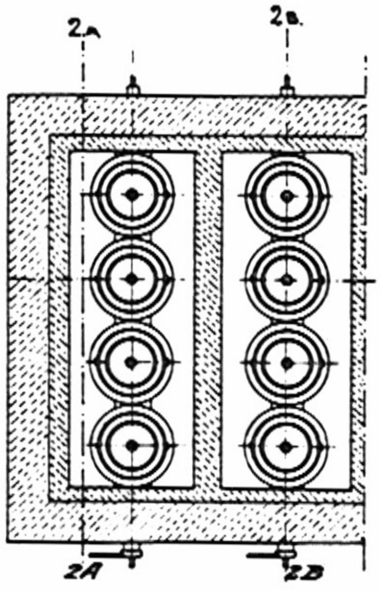


Fig. 3.

INVENTOR:

Sven Vilhelm Bergh

Patented Feb. 22, 1927. **1,618,566**

UNITED STATES PATENT OFFICE.

SVEN VILHELM BERGH, OF STOCKHOLM, SWEDEN.

FURNACE AND APPARATUS FOR UTILIZING SHALE OR OTHER BITUMINOUS MATERIALS.

Application filed September 25, 1923, Serial No. 664,794, and in Sweden September 18, 1922.

This invention relates to improvements in or relating to furnaces and apparatus for the purpose described.

The main object of the invention is to effect in a continuous process by means of a simple and convenient arrangement of apparatuses the distillation of said bituminous material to obtain, a good quantity and quality of oil, a gas of a high calorific value and at the same time to improve the manner of gasifying and burning the coke-residue from said distillation to utilize the heat from this combustion for different heating purposes in combination with said distilling process.

Another object is to provide an apparatus, in which vital parts such as the retorts, etc., can easily be removed for repairs.

A further object is that the plant, as built in units, can easily be enlarged. Other objects and advantages of the invention will appear as the following description is read in connection with the accompanying drawing.

In the drawing:

Figure 1 is a vertical section along the line 1—1 in Figure 3 and also a side elevation of the invention.

Figure 2 shows vertical sections along the lines 2^a—2^a and 2^b—2^b in Figure 3.

Figure 3 shows a horizontal section along the line 3—3 in Figure 1.

Similar numerals refer to similar parts.

According to the Figures 1, 2 and 3 a number of heating chambers 1, shaped as shafts, are grouped to form a furnace-block or battery 2. The block is constructed of bricks with linings of refractory material, the whole suitably being enclosed in a frame work of structural steel. In the upper part of each heating chamber 1 is arranged a row of retorts 3, which by means of screw-bolts are joined to a drying or supply bunker 4, supported by the brickworks by means of angle irons 30 or the like. The drying or supply bunker 4 is generally left open but can also conveniently be provided with covers 5. Each of the retorts is arranged with vapour-mains 6 for drawing off gaseous products. The vapour mains 6 descend to the lower portion of the retorts. If wet fuel is to be worked, the drying bunkers 4 are also provided with vapour outlets 7. which by means of pipes (8) are connected to combustion chambers 9, the latter being enclosed in the lower portion of the heating chamber 1. In the lower portion of each retort is at different levels vapour inlets 10 arranged for introducing steam or inert gas or a mixture of the same. The inlet pipes 10 are inserted into the retort behind a baffle plate 11 open in its upper and lower end towards the retort, which baffle plate is placed in the neighborhood of the vapour drawn off 6. Steam, superheated or inert gas is used among other means for carrying heat to the distilling zone and to serve as means to prevent the admission of air. In the upper portion of the heating chamber 1 between retorts and chamber walls steam producers 12 and superheaters 13 are arranged, the steam superheaters being by means of pipes 14 connected to the steam producers. The lower end 10 of the steam superheaters 13 are connected to the lower portion of the retort so that steam can be inserted between retort wall and baffle plate 11. Pipes 8 connect the steam producers with combustion chambers 9. The lower open ends of the retorts are suitably protected against being corroded by using the shoes 18 of some suitable material. Below the row of retorts is placed a bar 15, which preferably is constructed hollow and provided with an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool the bar. The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range. which reacts upon the distilling process. Below the bar 15 is arranged a wall 19 dividing the lower part of the heating chamber into the above mentioned combustion chambers 9. At the bottom of the heating chamber is arranged a mechanically operated discharging arrangement for ashes consisting of two rotating bars 20 provided with teeth. This bar 20 works against a pair of turnable bottom plates 21, secured to shafts 22. The plates 21 are fixed in a certain position by means of stoppers 23 or the like. The motion of the bar 20 is produced by means of the lever 25 and gears 26, which are connected to a transmission and a motor. The lower parts of the combustion chambers and the ashpit are provided with air and steam inlets 28 placed at suitable levels.

The products of combustion obtained from burning the cake residue pass first over the heating surfaces of the retorts, steam producers and superheaters and then to stacks 27.

The volatile products of distillation are drawn off through the vapour mains 29 arranged on the outside and along the upper part of the battery 2. From the main 29 the volatile products are in ordinary way conducted to a condensing and scrubbing plant wherein oily and other valuable products are removed and the remaining permanent gas is lead to a gas holder from which it later is distributed for different purposes. A part of the gas may if convenient be used over again by circulating through a heater and the retort. Various modifications, however, may be made in the apparatus for carrying out the invention without departing from the principle of the invention.

What I claim and desire to secure by Letters Patent is:—

1. In a device of the character described in combination, a vertical retort provided with a leading off vapour main centrally placed finishing in the lower portion of said retort; steam producers placed on sides of said retort and connected to the lower portion of said retort through steam superheaters; and watercooled surfaces placed below said retorts.

2. In a device of the character described in combination, a battery of heating chambers, retorts, hanging in each of said heating chambers, the retorts being open in its lower ends; combustion chambers for burning solid fuels arranged in the lower portion of said heating chambers, and communicating with said retorts; means for introducing air and steam in said combustion chambers; means for mechanically discharging the ashes from said combustion chambers; and means for drawing off the products of combustion from said heating chambers.

3. In a device of the character described in combination, a battery of heating chambers, retorts hanging in said heating chambers; drying bunkers for fuel placed at the top of said retorts; means for conducting vapours away from said drying bunkers; means for introducing gaseous products into said retorts; means for drawing off vapours from the lower part of said retorts; steam producers placed outside said retorts and arranged in the upper portion of said heating chambers; means for regulating the temperature of said coke-residue; combustion chambers arranged in the lower portion of said heating chambers and communicating with said retorts; means for introducing air and steam in said combustion chambers; means for mechanically discharging the ashes from said combustion chambers; means for introducing vapours from said drying bunkers into said combustion chambers; and means for drawing off the products of combustion of the coke-residue from the heating chambers.

4. In a device of the character described in combination, a battery of heating chambers, a row of retorts hanging in said heating chamber; a supply bunker for fuel placed at the top of said retorts; inlet pipes for introducing superheated steam into the lower portion of said retorts; baffle plates for distributing the steam at different levels in said retorts; vapour mains for drawing off gaseous products from the neighbourhood of said baffle plates; steam producers and superheaters placed outside said retorts and arranged in the upper portion of said heating chambers; a water-cooled bar placed below said row of retorts; combustion chambers arranged in the lower portion of said heating chambers and communicating with said retorts; means for introducing steam from said steam producers and superheaters in the retorts; inlet pipes for steam and air in said combustion chambers; discharging bars with teeth for ashes working against turnable bottom plates, fixed stoppers for said bottom plates and stacks for said furnace battery.

In testimony whereof I have signed my name to this specification.

SVEN VILHELM BERGH.

Nov. 4, 1930. F. J. McDEVITT 1,780,653

ACID SLUDGE BURNER

Filed May 26. 1927 2 Sheets-Sheet 2

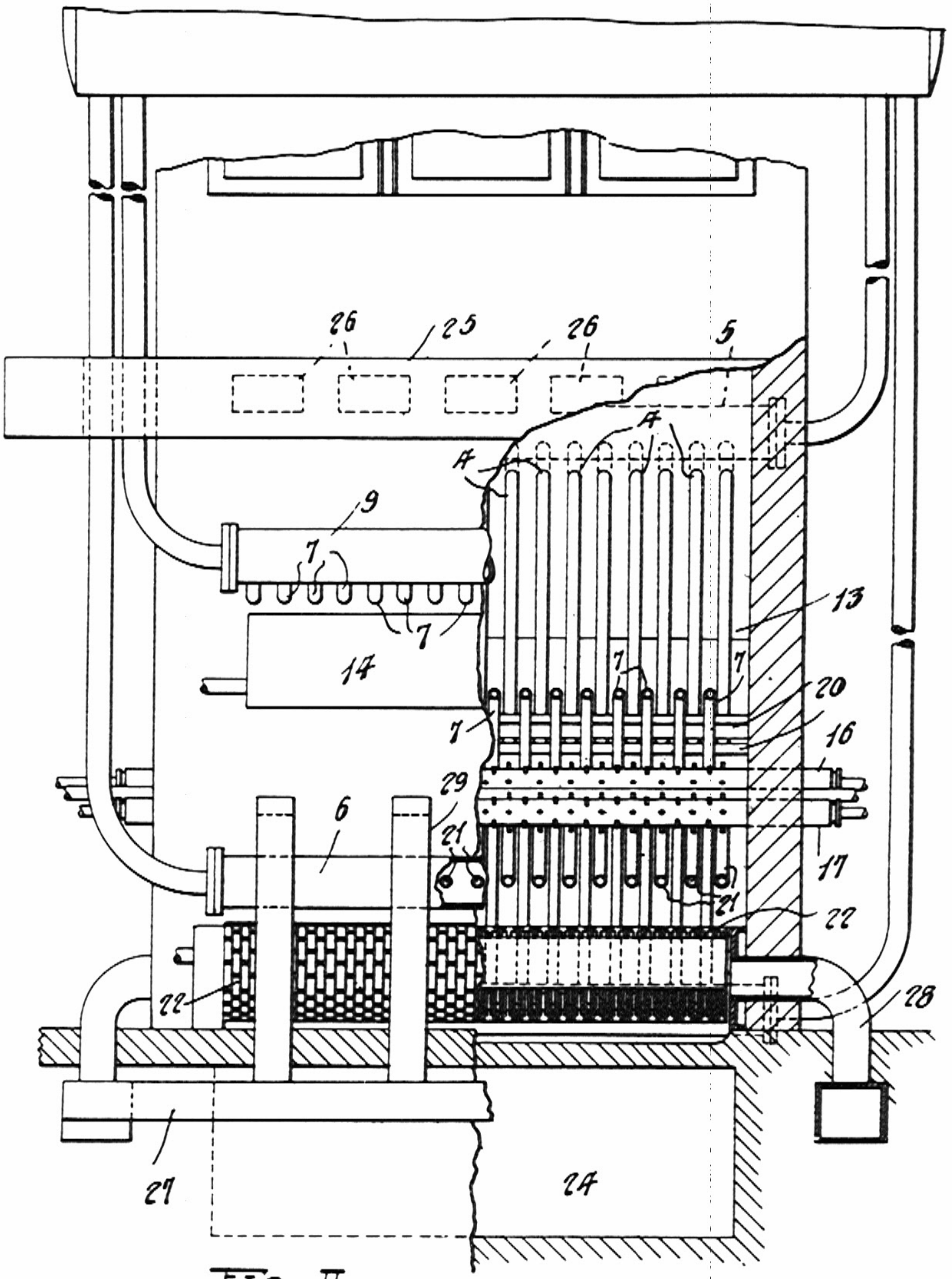


FIG. II.

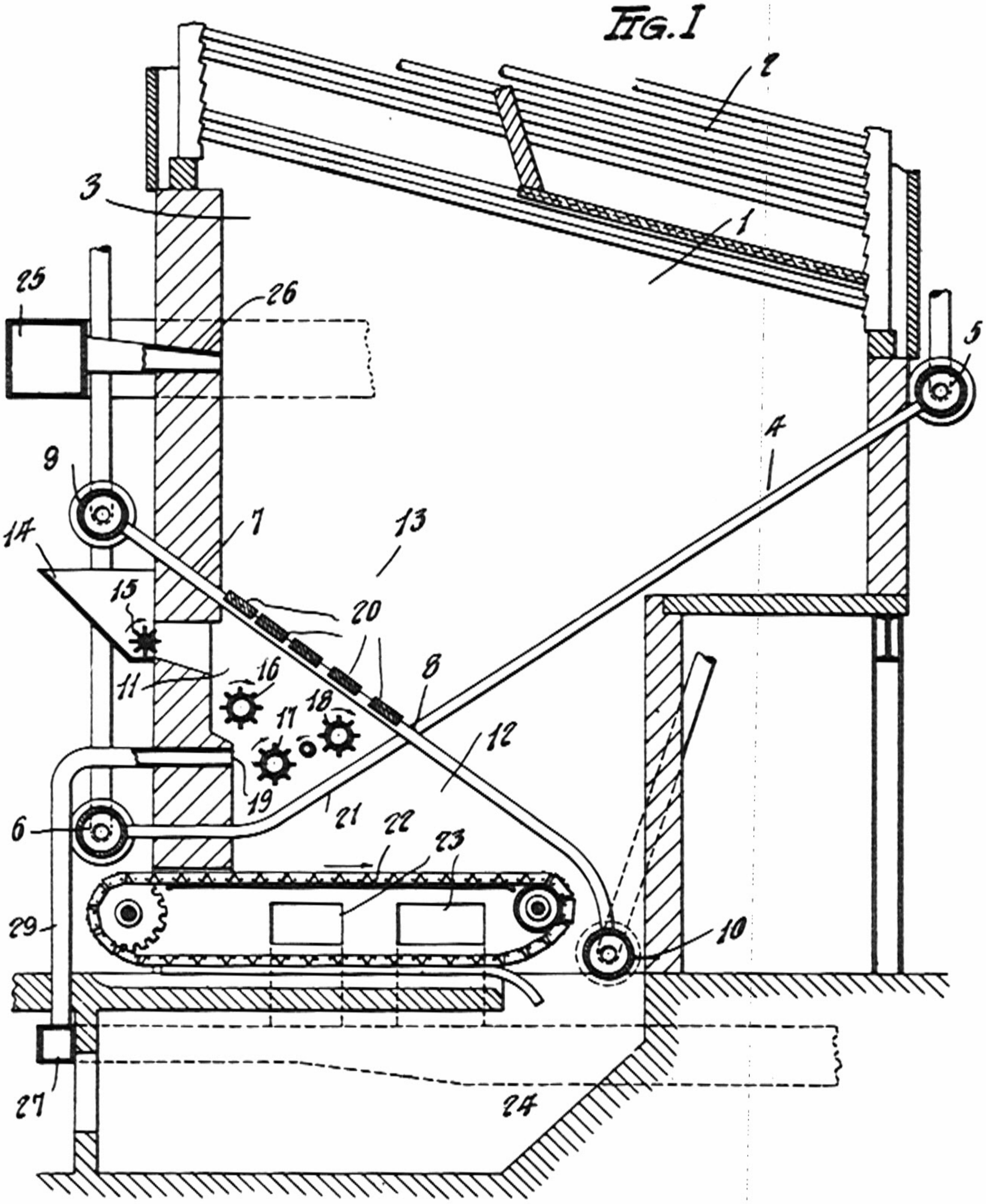
INVENTOR
F.J. McDEVITT
BY
ATTORNEY

Nov. 4, 1930. F. J. McDEVITT 1,780,653

ACID SLUDGE BURNER

Filed May 26. 1927 2 Sheets-Sheet 1

FIG. I



INVENTOR
F. J. McDEVITT
BY J. G. Cook
ATTORNEY

Patented Nov. 4, 1930 **1,780,653**

UNITED STATES PATENT OFFICE

FRANK J. McDEVITT, OF ST. LOUIS, MISSOURI

ACID-SLUDGE BURNER

Application filed May 26, 1927. Serial No. 194,499.

This invention relates to acid sludge burning furnaces.

The primary object of the invention is to provide a multiplicity of chambers or zones within the confines of the furnace for distilling the sludge, feeding the resultant coke or carbonaceous material to a carbon zone where combustion of the carbon and coke takes place, and in providing another zone or combustion chamber wherein final or complete combustion of the gases evolved from the combustion and distillation zones takes place.

Another object of the invention comprehends the provision of means for thoroughly mixing, in the final zone, rich gases obtained from the distillation zone and the relatively poor or lean gases evolved from the aforesaid combustion zone.

Another object of the invention is to provide means for affording protection from the heat to the lowermost chambers wherein distillation and combustion, respectively, takes place.

More specifically, the invention comprehends the idea of arranging protecting tubes which are preferably attached to the headers of the boiler system, in such a manner that they are diagonally disposed and interlaced, thereby to define a lower combustion chamber, a superposed distillation chamber and an uppermost gas combustion chamber for the evolved gases.

Still another object of the invention is to provide agitators positioned within the distillation chamber and designed to be rotated or oscillated to prevent caking of the sludge.

Numerous other objects of the invention will be apparent from the reading of the following specification when read in conjunction with the drawings attached hereto and forming a part hereof, in which—

Figure 1 represents a longitudinal sectional view of the furnace, and

Figure 2 a front view partly in section, exposing some of the apparatus for carrying out the operation.

Referring now more specifically to the drawings, wherein like reference characters represent like parts, 1 designates a furnace generally, having the conventional water tubes 2 and the customary lower combustion space 3. Within the interior of this furnace space I provide a multiplicity of diagonally arranged water tubes 4 connected to the headers 5 and 6 respectively, and a second series of water tubes 7 crossing the first series of such tubes as at 8, and interlaced therewith, which secondary series of tubes are connected with the headers 9 and 10 respectively. These two series of crossed water tubes assist in defining a distillation zone or chamber 11, a lower carbon combustion chamber 12 and a gas combustion chamber 13, which latter chamber receives the rich and relatively lean evolved gases from the distillation and combustion chambers. Acid sludge is introduced by the hopper designated by the reference numeral 14, having a rotating feeder 15 for discharging the acid sludge within the confines of the chamber 11. This chamber is preferably provided with a series of agitators 16, 17 and 18 respectively, preferably water cooled, designed to constantly agitate the sludge during the distillation operation without permitting the coking thereof. To assist the distillation operation I preferably introduce heated air through a series of ducts 19, which air will preferably have a static pressure of approximately 1″ water gauge and will be preheated to a temperature of approximately 400° F.

The distillation within the chamber 11 will drive off the volatile matter which arises through spaces provided between the tile slabs 20 supported by the tubes 8. This evolved gas is very rich, consisting mostly of hydrocarbons.

After the volatile matter has been driven off in the distillation chamber the coke which is left drops through the lower protecting tubes 21 onto the chain grate stoker 22 traveling in the direction shown by the arrow where further combustion takes place within the said carbon combustion chamber 12. It is very essential that the protecting tubes be so arranged as to protect the stoker from the intense heat within the combustion chamber 13. Inasmuch as very little ash is left within the coke it is necessary to employ excess air for the combustion thereof. This air, preferably in a heated condition, and from the supply fed through the duct 19, aforesaid, is admitted through ducts 23. This air, as above stated, is under pressure and temperature.

The conveyor 22 delivers the ashes to the pit 24 positioned below the same.

It is highly important that the heat derived from the combustion of the gases within the chamber 13 be prevented from substantially affecting the lower chambers comprising the distillation zone for the sludge and the carbon combustion zone. To this end the diagonally arranged tubes are closely positioned and moreover transverse tile slabs are provided as at 20 to afford an adequate protection against heat for the distillation chamber while at the same time such slabs are spaced sufficiently to permit the evolved gases to escape from within the distillation chamber into the gas combustion chamber 13.

It will be apparent that the gases evolved from the distillation chamber will be quite rich consisting essentially in hydrocarbons and these gases will pass to the forward part or front of the furnace. On the other hand the gases obtained from the distillation of the carbonaceous substance is of relatively lean character and will tend to accumulate within the rear portion of the furnace. It is quite essential that these gases be mixed and a proper amount of air supplied for complete combustion and to this end I provide a conduit 25 having inlet ducts 26 communicating therewith and discharging into the front of the furnace whereby both the lean and rich gases are blown to the rear of the furnace where they are thoroughly mixed and complete combustion takes place. The products of this combustion then, of course, rise through the heating surface of the boiler attached to the top of the furnace and designated by reference numeral 2.

By reference to Figure 2, it will be noted that the conduits for supplying the air comprise a transverse tubular element 27 having a connection 28 for discharging the heated air within the carbonaceous combustion chamber at the point indicated by reference numeral 23. To this same source of air supply the vertically extending connections 29 are attached which terminate in the front wall of the furnace as shown by reference numeral 19.

Briefly the operation of the acid sludge furnace is as follows:

The acid sludge is introduced by hopper 14 into the distillation chamber 11 wherein it is thoroughly agitated to prevent caking thereof. The agitator 16 is of tubular formation and connected with the boiler system. The carbonaceous material deposits itself upon the conveyor 23 within the confines of the lower primary combustion chamber and the evolved gases escape upwardly therefrom. The resultant ashes are deposited within the ash pit 22. By virtue of the arrangement of the water tubes the different chambers herein referred to are formed and these water tubes are likewise connected with the boiler system. To protect the lower chambers from the intense heat of the gas combustion chamber 13 I provide tiles. As hereinbefore stated, the feature of thoroughly mixing the relative poor and rich gases evolved from the distillation and carbon combustion chambers respectively is quite important.

It will be apparent to those skilled in the art that many changes in the construction and arrangement of parts may be made without departing from the spirit of the invention as expressed in the following claims.

I claim:

1. A furnace for burning acid sludge comprising an enclosure having walls, a series of tubes arranged diagonally with respect to walls of said enclosure and connected with the boiler system of the furnace, and a secondary series of tubes diagonally arranged with respect to the walls of said enclosure but oppositely positioned with respect to the first-mentioned tubes, the first mentioned and second mentioned tubes crossing each other intermediate their ends to define a plurality of walls of a distillation chamber, a carbon combustion chamber and a gas combustion chamber, and means for feeding acid sludge to the distillation chamber.

2. A furnace for burning acid sludge comprising an enclosure having walls, a series of tubes arranged diagonally with respect to walls of said enclosure and connected with the boiler system of the furnace, and a secondary series of tubes diagonally arranged with respect to the walls of said enclosure but oppositely positioned with respect to the first-mentioned tubes, said tubes crossing each other intermediate their ends to define a plurality of walls of a disillation chamber, a carbon combustion chamber and a gas combustion chamber, and means for feeding acid sludge to the distillation chamber, and rotating water tubes connected with the water system for agitating the sludge undergoing distillation within said distillation chamber.

3. A furnace for burning acid sludge comprising an enclosure having walls, two series of oppositely extending water tubes connected with the boiling system of the furnace and interlaced with each other and associated with walls of said enclosure to provide a plurality of side walls of a distillation chamber, a carbon combustion chamber, and a gas combustion chamber, means for feeding acid sludge to the distillation chamber, means for feeding heated air to said distillation chamber, said

carbon combustion chamber being adapted to receive carbonaceous material from said distillation chamber, said gas combustion chamber being adapted to receive the relatively rich and lean gases evolved from the distillation and carbon combustion chambers respectively.

4. A furnace for burning acid sludge comprising an enclosure having walls, two series of oppositely extending water tubes connected with the boiling system of the furnace and interlaced with each other and associated with walls of said enclosure to provide a plurality of side walls of a distillation chamber, a carbon combustion chamber, and a gas combustion chamber, means for feeding acid sludge to the distillation chamber, means for feeding heated air to said distillation chamber, said carbon combustion chamber being adapted to receive carbonaceous material from said distillation chamber, said gas combustion chamber being adapted to receive the relatively rich and lean gases evolved from the distillation and carbon combustion chambers respectively, and means for supplying heated air to said gas combustion chamber.

5. A furnace for burning acid sludge comprising an enclosure having walls, two series of oppositely extending water tubes connected with the boiling system of the furnace and interlaced with each other and associated with walls of said enclosure to provide a plurality of side walls of a distillation chamber, a carbon combustion chamber, and a gas combustion chamber, means for feeding acid sludge to the distillation chamber, means for feeding heated air to said distillation chamber, said carbon combustion chamber being adapted to receive carbonaceous material from said distillation chamber, said gas combustion chamber being adapted to receive the relatively rich and lean gases evolved from the distillation and carbon combustion chambers respectively, and means for protecting the distillation chamber from the heat of the gas combustion chamber.

6. A furnace for burning acid sludge comprising an enclosure having walls, two series of oppositely extending water tubes connected with the boiling system of the furnace and interlaced with each other and associated with said enclosure to provide a plurality of side walls of a distillation chamber, a carbon combustion chamber, and a gas combustion chamber, means for feeding acid sludge to the distillation chamber, means for feeding heated air to said distillation chamber, said carbon combustion chamber being adapted to receive carbonaceous material from said distillation chamber, said gas combustion chamber being adapted to receive the relatively rich and lean gases evolved from the distillation and carbon combustion chambers respectively, and means for protecting the distillation chamber from the heat of the gas combustion chamber, said means comprising a series of spaced tiles mounted on a portion of said water tubes.

7. An acid sludge burning furnace comprising an enclosure having walls, a distillation chamber having its upper and lower walls formed by two series of closely arranged water tubes connected with the boiler system of said furnace and associated with a wall of the enclosure to produce said distillation chamber, a gas combustion chamber located thereabove, means for feeding acid sludge to the distillation chamber wherein gases are evolved and ascend into the combustion chamber, a series of tile slabs associated with said water tubes to prevent a substantial amount of the heat from the gas combustion chamber from entering the distillation chamber.

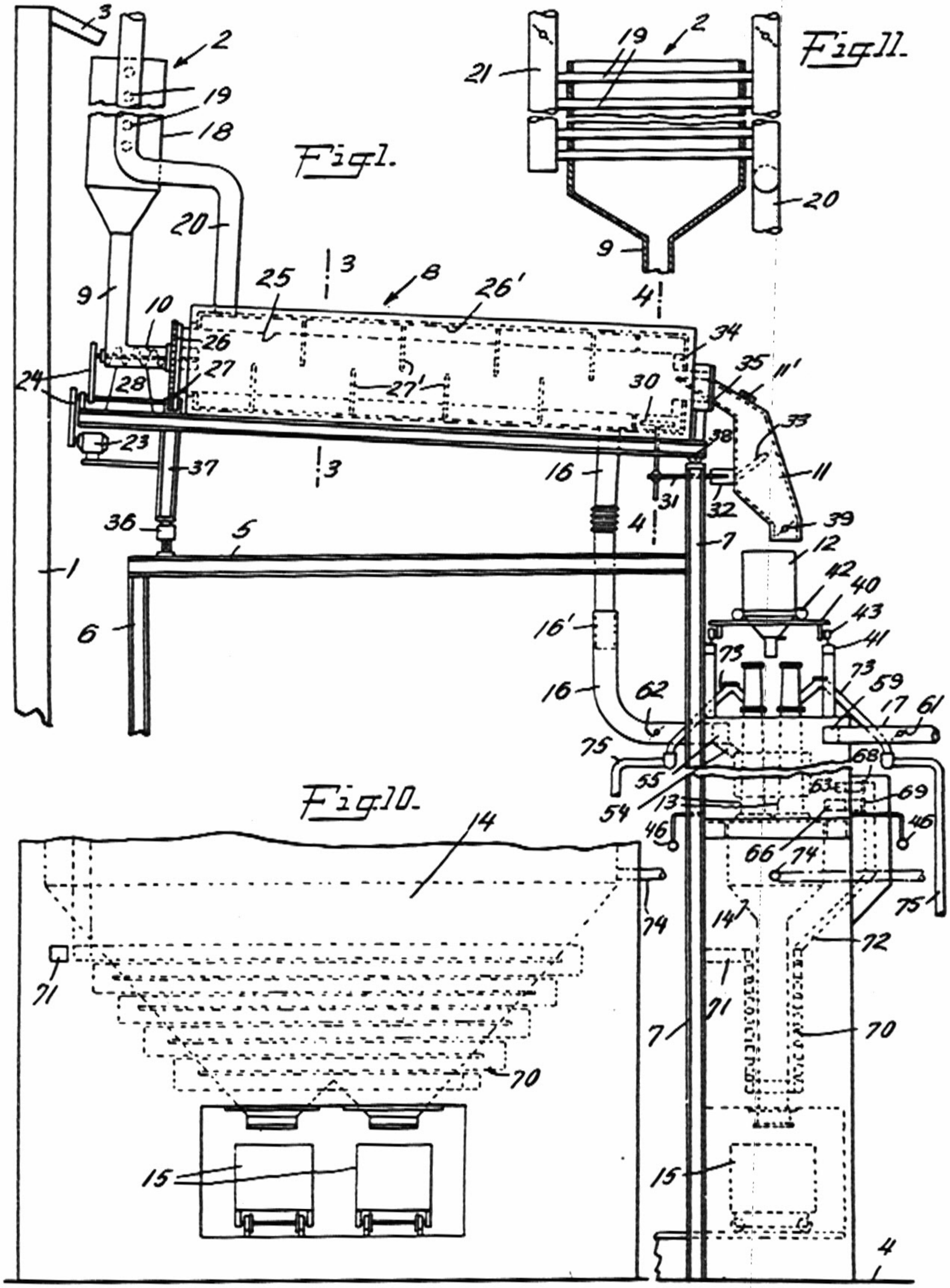
In testimony that I claim the foregoing I hereunto affix my signature.

FRANK J. McDEVITT.

Oct. 13, 1931. S. W. PARR ET AL 1,827,483

APPARATUS FOR COKING COAL

Original Filed Jan. 2, 1926 4 Sheets-Sheet 1



INVENTOR
Samuel W. Parr
Thomas E Layng

BY Pennie Davis Marvin & Edmonds
ATTORNEYS

Oct. 13, 1931. S. W. PARR ET AL 1,827,483

APPARATUS FOR COKING COAL

Original Filed Jan. 2, 1926 4 Sheets-Sheet 2

Fig. 2.

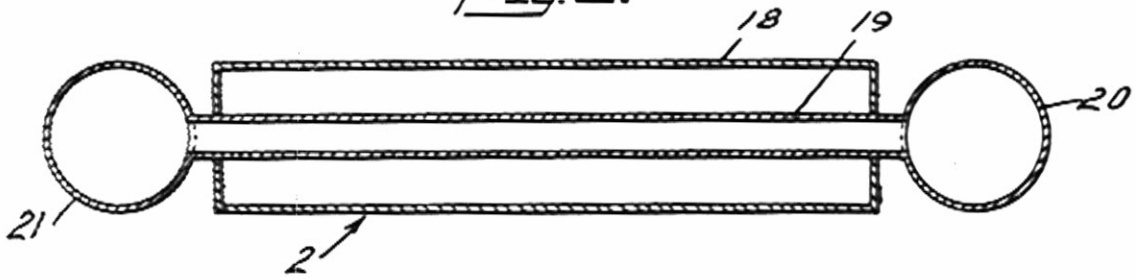


Fig. 3.

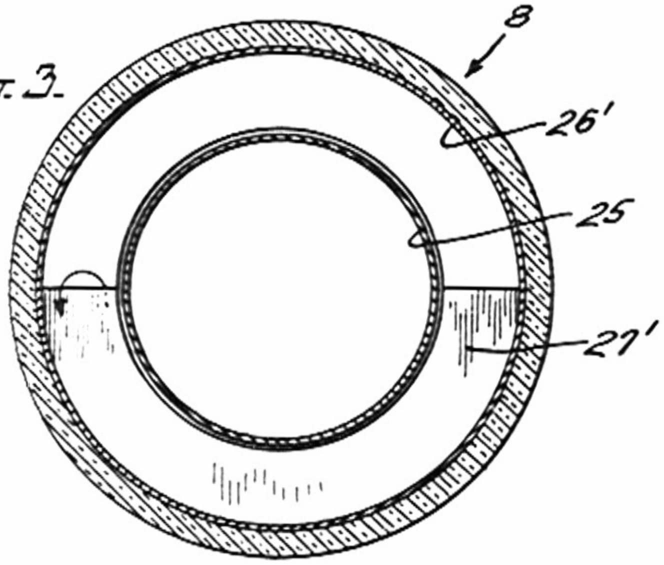
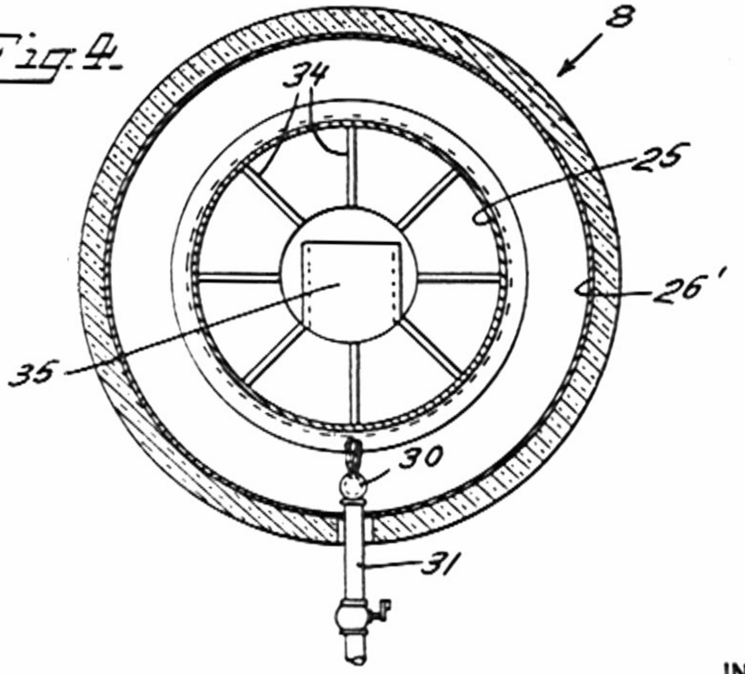


Fig. 4.



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Oct. 13, 1931. **S. W. PARR ET AL** **1,827,483**

APPARATUS FOR COKING COAL

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Fig. 5.

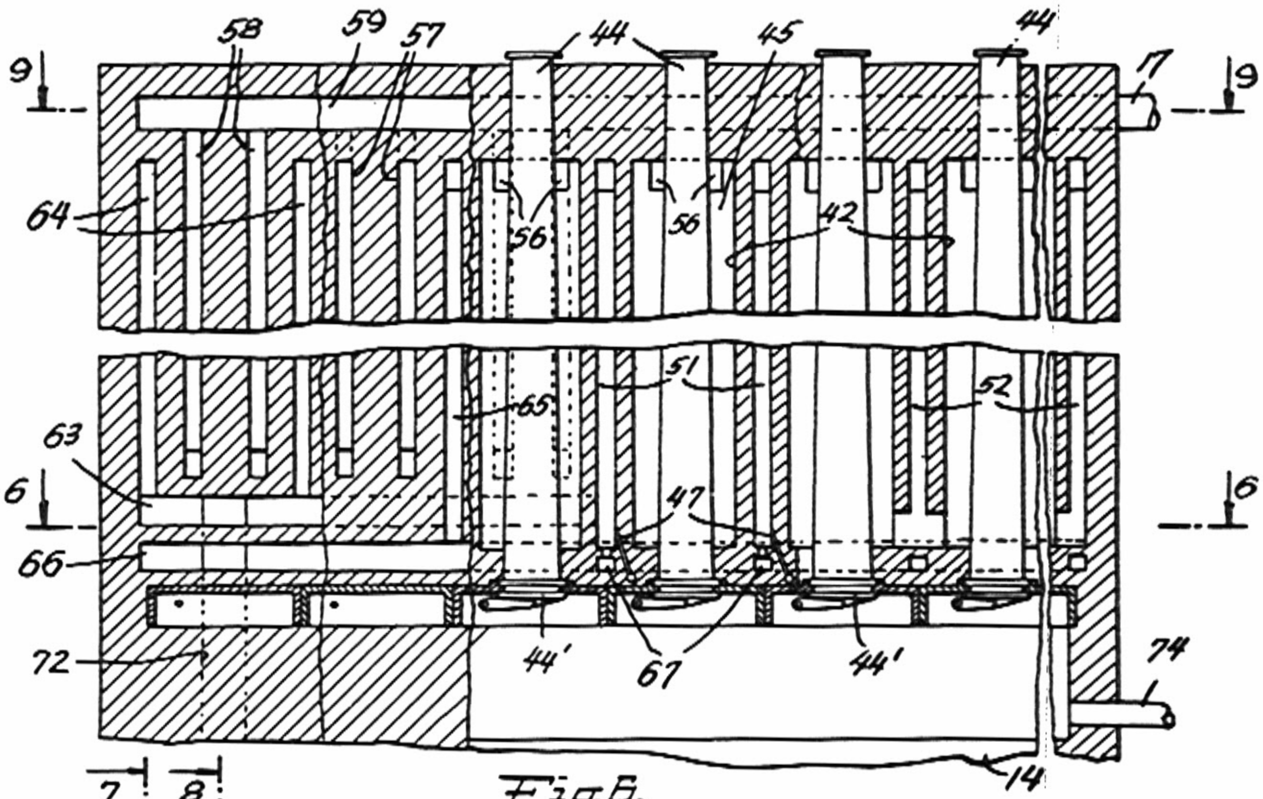

Fig. 6.

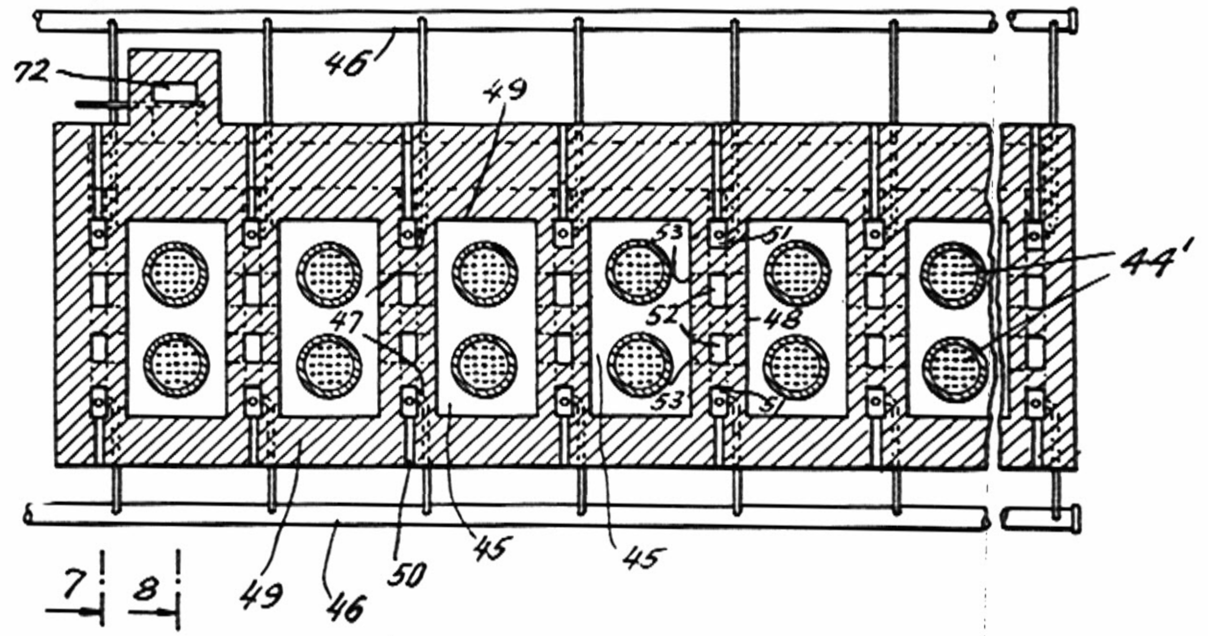

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Fig. 7.

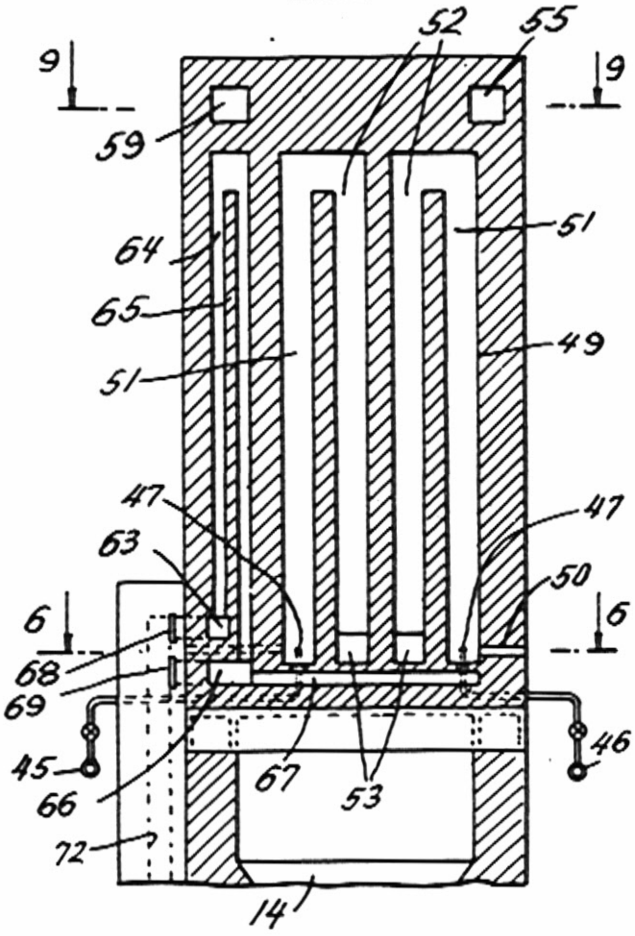


Fig. 8.

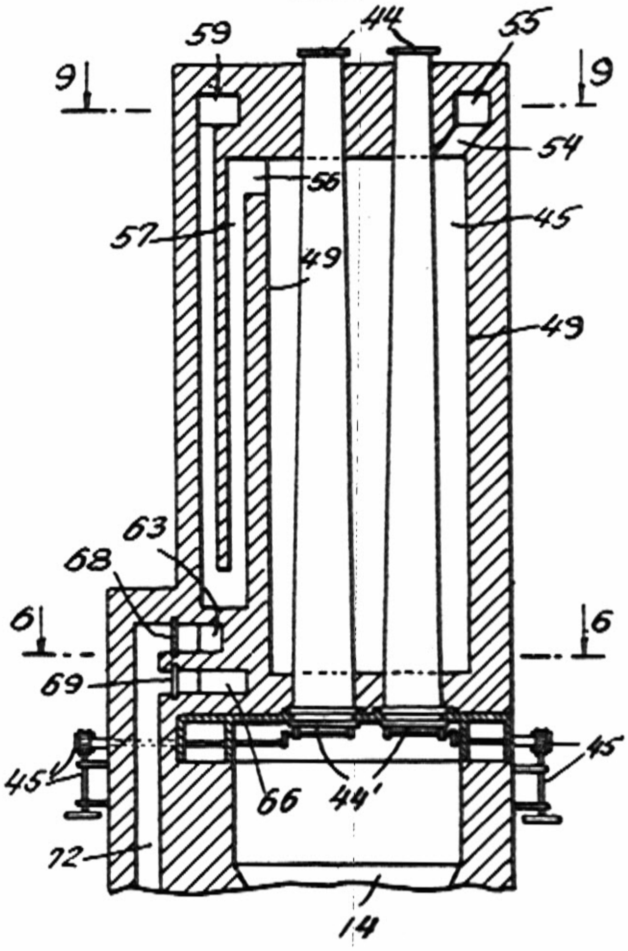
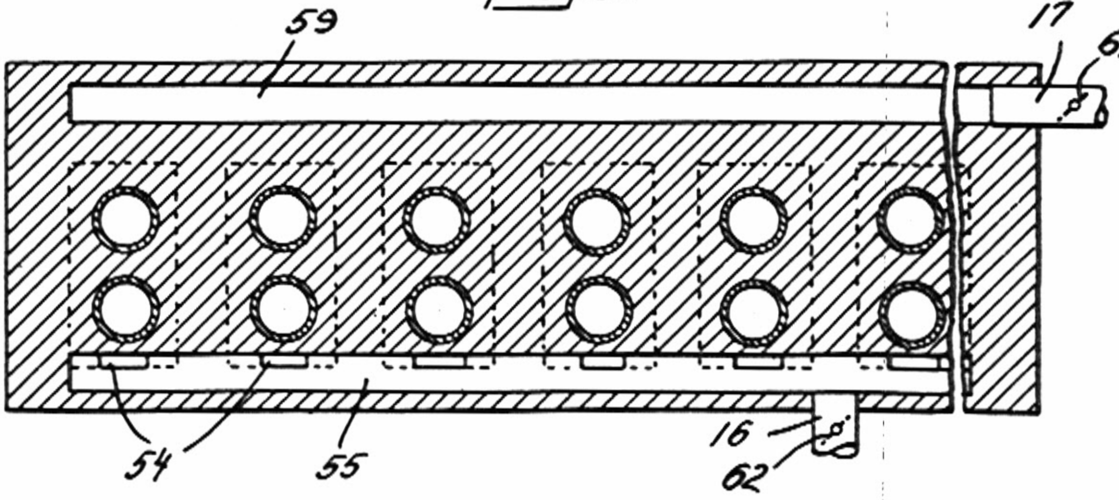


Fig. 9.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR COKING COAL

Original application filed January 2, 1926, Serial No. 78,959. Divided and this application filed March 26, 1926. Serial No. 97,518.

Our invention relates to the treatment of coal for the purpose of educing hydrocarbons therefrom and converting the fuel into coke; and more particularly to an apparatus whereby such treatment can be carried out. This application is a division of our application Serial No. 78,959 filed January 2, 1926, wherein claims are made on the process herein disclosed.

According to present practice, coal is coked either in "bee-hive" ovens or in the more modern by-product ovens. In the former type, the coal is spread upon a hearth and ignited with insufficient supply of air and the volatile constituents of the fuel are all either consumed or wasted. In the ordinary by-product process, the coal is charged into externally heated coking chambers and the gases and vapors are led away for recovery of the valuable constituents. In both of these processes the coal is submitted to temperatures and to conditions which are not conducive to economical production of the desired products, and in the case of the by-product processes the vapors are exposed to temperatures and conditions which seriously reduce the proportions of some of the more valuable constituents and bring about secondary reactions which yield undesirable products.

The present invention relates particularly to by-product practice; that is to say, the coking is done in a coking chamber and the gases and vapors are led away for the recovery of their valuable constituents. It is the purpose of our invention to provide an apparatus whereby fuel can be coked so as to produce, even from poorly coking coals, a high grade product and educe the volatile constituents without setting up undesirable secondary reactions. A further object of our invention is to reduce the consumption of fuel employed in the operation and to shorten the time for carrying out the carbonization process. Another object is to make available for use in by-product practice, coals of the character now commonly designated as "non-coking coal". Our invention makes it possible to produce from either coking coals or so-called "non-coking" coals a coke particularly adapted for domestic use or, if desired, a coke for metallurgical purposes, while at the same time securing as by-products oils, tars and other products, rich in valuable constituents and less contaminated with objectionable substances than is the case with ordinary by-product processes.

In general our process consists of heating fuel such as coal to a uniform temperature close to but below the temperature at which hydrocarbon vapors begin to form, and then confining the fuel in a closed container and supplying it with sufficient heat to complete the coking operation. The preliminary heating up to close to the critical temperature is best performed by agitating the fuel while supplying heat thereto. We prefer to carry out the process in this manner so as to avoid the formation in the body of fuel of zones of different temperatures in which the fuel is in various stages of decomposition and where part of it is converted prematurely into coke. Where fuel is placed in the ordinary by-product retort and slowly heated to the usual coking temperature of from 900 to 1000° C., the heat slowly penetrates the fuel due to the low heat conductivities of some of the layers of the fuel. As a result, the outside layer is heated to a very high temperature before the central portion of the mass of fuel is heated sufficiently to give off its volatile matter.

According to the preferred embodiments of the present invention, the fuel is first flooded with heat uniformly throughout, that is, extraneous heat is supplied to the fuel in a closed container so as to rapidly bring the temperature of the fuel up to close to the critical temperature at which hydrocarbon vapors are educed. Thus all of the fuel is heated up to a temperature near the critical temperature in the most efficient manner. The fuel while being so treated is brought into an improved condition for the carbonization process which is to follow, through the instrumentality of certain reactions which result in the removal of deleterious oxygen and oxygen compounds such as H_2O and CO_2. These reactions if allowed to occur simultaneously with the reactions of the carbonization stage would result in a weakening of the bonding material and consequently produce a coke of inferior quality. It is to be understood that the reactions involved in the process of carbinization occur at temperatures accompanying and immediately following the pasty stage and are entirely different in character from those of the preliminary treatment stage. There is, therefore, the advantage that the preheating may be not only so controlled as to bring the mass up to within a few degrees of the pasty stage where carbonization begins, but there is secured also a control of the chemical reactions involved whereby those of a deleterious character are segregated from the carbonization reactions, thus producing a stronger coke as well as discharging, as undesirable material, the CO_2 and H_2O resulting from the preliminary heating.

When the fuel reaches the critical temperature, and the decomposition process which results in the formation of coke begins, chemical reactions take place which generate a certain amount of heat. These exothermic reactions serve to change the chemical composition of the fuel in a pronounced manner and to raise the temperature of the mass to a considerable extent. A characteristic of our invention is the utilization of this exothermic heat in raising the temperature of the fuel after the preliminary heat treatment. Because of the fact that the fuel is first heated uniformly throughout up to close to the critical stage, the exothermic reactions augmented by the heat of the retort bring about the more pronounced exothermic reactions of decomposition and these occur throughout the whole mass of coal. This rise in temperature produces more exothermic reactions, and proceeds autogenously and with a cumulative effect so that not only does the pasty stage spread throughout the mass but the increased conductivity of the pasty condition promotes the transmission of heat from the retort walls and this together with the heat resulting from the reactions quickly carries the carbonization process to completion. The autogenous progression of the exothermic reactions oftentimes has the effect of subjecting the fuel at the center of the mass to higher temperatures than those obtaining near the outer edge of the mass.

We prefer to supply extraneous heat to the fuel while the exothermic reactions are taking place for the purpose of avoiding heat loss by radiacation, thus conserving the exothermic heat and supplying any heat which may be necessary to insure the progress of the exothermic reactions to the fullest extent and ultimately to convert the plastic mass into coke and without the necessity of carrying a high heat head on the exterior of the retort and so permitting of the maintenance of low temperature condition.

Although the preliminary heat treatment is preferably carried on while the fuel is being agitated, we have found that it is desirable to maintain the fuel in a quiescent condition while the exothermic reactions are taking place and the plastic mass converted into coke.

According to the preferred embodiments of our invention, the fuel is agitated during the preliminary heating thereof, and maintained substantially quiescent while it is being changed from a plastic mass to coke.

The preferred embodiments of our improved apparatus includes a device whereby fuel, such as coal, can be uniformly heated throughout up to close to the critical temperature. This means serves to heat the fuel in thin layers, or while it is being handled so that the heat quickly and uniformly reaches every part of the fuel undergoing treatment, thus insuring a uniform temperature rise throughout the body of fuel. Our preferred embodiment of this portion of the apparatus comprises a cylinder into which the raw fuel, preferably in finely ground condition, is charged and then simultaneously tumbled about and heated by revolving the cylinder or drum in a heating chamber. The cylinder or drum may be heated by flue gas or other waste gases, or a gas or oil burner can be installed in close proximity to the cylinder for the purpose of supplying heat thereto. We prefer to have the latter heating device available to serve as at least an auxiliary heating means for the reason that it makes it possible to control the heat in such a manner as to bring the mass to the exact temperature prescribed for the particular coal in hand.

The other principal part of the apparatus consists of a retort, or preferably a group of retorts, into which the uniformly preheated fuel is deposited for the purpose of converting it into coke and discharging the hydrocarbon vapors which are educed as the temperature of the fuel increases. This retort is conveniently located in close proximity to the preheating device. We prefer to provide a chamber between the preheating device and the retort proper for the purpose of holding a reserve supply of preheated fuel. This reserve chamber should hold enough fuel to fill at least two retorts completely and it should be properly lagged to prevent radiation losses. The fuel itself is naturally a poor conductor of heat and experience has shown that there is a very slow heat loss through radiation at the temperatures employed, and the coke produced is of as high quality as that produced by charging the preheated fuel immediately into the retort. The retort may be of the vertical type in which the coal is introduced at the top and the coke is removed at the bottom. Means is provided for supplying heat to the outside of the retort for the purpose of raising the temperature of the fuel up to the point where the exothermic reactions commence and to supply whatever additional heat is necessary to conserve the exothermic heat and complete the coking operation.

Our process and the embodiment of our apparatus illustrated in the accompanying drawings can best be understood after a consideration of the nature of the material treated and its behavior at different temperatures.

It is well known that bituminous coal (and likewise semi-bituminous coal) consists mainly of lignin or so-called degraded cellulosic material, and resinic or bituminic substances resulting from the geological transformation of the vegetable matter in the formation of coal. The two main components of all coals of the bituminous or semi-bituminous types may be separated by using a suitable solvent such as phenol, and the characteristics of each component may be studied with reference to the rôle it plays in the coking reactions. The lignin, or insoluble part, consisting mainly of lignin, is one of the original components and also a resultant formed in the degradation processes affecting the original plant cellulose ($C_6H_{10}O_5$). In the transformations that have taken place, the greatest change probably has occurred with reference to the oxygen, which has dropped from a percentage of nearly 47 in the original cellulose, down to 12 or 15% in the cellulosic residue. This residue has certain specific properties of marked importance in connection with the coke formation. It does not melt or fuse together at any temperature and accordingly it has no coking or bonding property whatever. It is fairly stable and does not decompose by the action of heat up to a temperature of 200° C. Above that temperature, and especially as 300° C. is approached, certain initial decompositions begin, characterized mainly by a rearrangement of the elements of which the material is composed. Oxygen combines with hydrogen to form water and with carbon to form carbon dioxide and some carbon monoxide. At higher temperatures, decomposition of a positively different type occurs, which results in the formation of compounds of carbon and hydrogen, and of carbon, hydrogen and oxygen. Finally there is a residue of carbon, which is neither coherent nor caked and cannot be called coke.

The cellulosic residue has a marked avidity for oxygen which it readily absorbs and retains even though heated to a fairly high temperature. In fact, as the temperature is increased, the oxygen enters into chemical combination before being discharged.

The bituminic or soluble component of the bituminous or semi-bituminous types of coal is of a complex nature and includes substances directly related to the resins. These resinic substances have undergone very little decomposition. This component also includes pitch-like compounds in quantities predominating over the resinic substances; hence the designation "bituminic substance".

The soluble or bituminic substance has a much smaller percentage of oxygen and a greater percentage of hydrogen than the cellulosic component of the fuel. The bituminous substance is like the cellulosic material in that it resists decomposition at temperatures up to 200° C., but unlike this material, it softens and melts readily at temperatures above say 250° C. (the exact temperature depending upon the particular variety of coal), and this without appreciable decomposition of the carbon compounds until after a temperature of approximately 350° C. has been passed.

When both the cellulosic and bituminous substances are heated above the melting point of the soluble material, the latter, in effect at least, has the property of dissolving or agglomerating the cellulosic substance so that if the heating process is continued, the entire coal mass will be of a pasty or viscous consistency, and upon cooling from this point, will have a vitreous appearance and glistening fracture, indicating that the mass has become homogeneous throughout and has lost entirely the segregated or laminated structure of the original coal.

For some time it has been the generally accepted theory that the oxygen content of a coal is largely or entirely the criterion for determining whether that particular coal is a coking or a non-coking coal, and there is authority for the view that the ratio of oxygen to hydrogen available for combining therewith is the determining factor. Our investigations have demonstrated that the coking quality, as we shall hereinafter designate the capacity for producing a coke of high resistance to crushing strain, is promoted by the removal of the oxygen of the cellulosic substance in the form of H_2O and CO_2 or CO in a manner such as described under our discussion of preheating up to approximately 300° C.

Another feature of our invention consists of an improved furnace construction whereby heat can be supplied to the retorts in a very efficient manner, the intensity of heat being substantially uniform throughout the length of each retort. According to our invention the hot gases are used first to heat a refractory wall which in turn radiates heat to the retorts. The gases are finally led into direct contact with the retorts and are finally discharged into the preheating chamber of the preheating device.

The preheating treatment is used for the purpose of heating the raw coal up to a uniform temperature close to the critical temperature, that is, close to the temperature at which the coal would become plastic. Most kinds of bituminous coal become plastic throughout at a temperature somewhere between 325° C. and 450° C. The particular temperature at which a given kind of coal becomes plastic is fairly constant, and can be readily determined. Accordingly, it is entirely feasible to control the supply of heat to the preheating drum so as to increase the temperature of the fuel up to a predetermined value below that at which the fuel would become plastic.

It is desirable to supply the additional heat necessary to cause the preheated fuel to become plastic, as rapidly as possible. If this additional heat is applied slowly the melting point of the fuel is raised, and, indeed, it is possible to heat coals of certain varieties having a high deleterious oxygen content, so slowly that the property of becoming plastic is entirely destroyed. For this reason, it is desirable to bring about the change from the dry preheated state as rapidly as possible. It is not necessary to supply this additional heat to the preheated fuel immediately after it has been preheated, because until the plastic temperature is practically attained there is no danger of the heat treatment being carried out so slowly as to destroy the capacity of the fuel for becoming plastic.

In carrying out our invention we prefer to utilize the waste flue gases for preheating the coal in the preheating chamber, and the gases may thereafter be passed in heat exchanging relation to the raw coal being fed to the preheating drum. In this way the flue gases are utilized to the best advantage, the final temperature of the gases being little above that of the raw coal being fed to the preheating chamber. We also prefer to preheat the air which is supplied to the combustion chamber of the furnace by passing this air in heat exchanging relation to the coke withdrawn from the retorts. Where the supply of flue gases from the retort is in excess of that required to preheat the coal in the preheating drum, we prefer to use some of these gases to further heat the air supplied to the combustion chamber. For this purpose we have provided a recuperator which can be used whenever there is an ample supply of flue gases. Another feature of our invention consists of a storage chamber for coke discharged from the coking retorts, and we prefer to provide means for withdrawing any vapors or gases formed in this coking chamber. These gases and vapors are of a character similar to those withdrawn from the coking retorts and may be mingled with the gases from these retorts.

The various objects and advantages of our invention can be best understood by considering the accompanying drawings which illustrate one embodiment of the improved apparatus by means of which our improved process can be performed. In the accompanying drawings:

Fig. 1 is an elevation of a coking apparatus embodying our invention;

Fig. 2 is a vertical section view of the preheating apparatus shown in Fig. 1;

Fig. 3 is a transverse section view taken on line 3—3 of Fig. 1, showing the construction of the preheating device;

Fig. 4 is a transverse section view taken on line 4—4 of Fig. 1 showing further details of construction of the preheating device;

Fig. 5 is a vertical section view of the battery of retorts shown in Fig. 1,—parts being cut away to show the details of construction;

Fig. 6 is a transverse section view taken on line 6—6 of Fig. 5, showing the construction of the battery of retorts;

Fig. 7 is a transverse vertical section view taken on line 7—7 of Fig. 6;

Fig. 8 is a transverse vertical section view taken on line 8—8 of Fig. 6;

Fig. 9 is a longitudinal section view taken on line 9—9 of Fig. 5;

Fig. 10 is an enlarged elevation of the coke storage chamber shown at the bottom of Fig. 1; and

Fig. 11 is a transverse section view of the coal hopper showing the heating pipes extending therethrough.

The apparatus shown in Fig. 1 comprises a hoist 1 for elevating previously ground coal up to the top of the structure where it can be dumped into a hopper 2 through a chute 3. The hoist 1 may extend from the basement floor 4 of the building containing the apparatus, or merely from the floor above shown at 5. Suitable columns 6 and 7 support the floor 5 and support one end of the preheating device indicated generally by the reference character 8. The fuel hopper 2 communicates with the fuel preheating device 8 by means of a chute 9 and a screw conveyor 10. The preheating device 8 communicates with a discharge hopper 11 which empties into a car or lorry 12. This lorry can be moved back and forth along the top of a battery of coking retorts 13 so that fuel can be discharged from the lorry into any one of these retorts. From the retorts, where the fuel is converted into coke, the fuel is discharged into a coke storage chamber 14. The coke can be discharged from this chamber into cars 15 which carry the coke away from the apparatus.

Air is passed through a number of passages surrounding the coke storage chamber 14 and then supplied to a combustion chamber at the base of the coking retorts 13. The flue gases from the flues surrounding the retorts may pass through a pipe 16 into flues surrounding the preheating drum. Some of these gases instead of being utilized in the preheating device may be passed through a recuperator directly adjacent to the coking retorts and ultimately discharged through a pipe shown at 17 in Fig. 1.

The several parts of our improved appara-

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tus described in general terms in preceding paragraphs will now be described more in detail.

In Figs. 2 and 11 we have illustrated the preferred construction of the raw fuel hopper which supplies fuel to the preheating device. This hopper comprises a suitable container 18 having an open top for receiving coal from the hoisting device 1. A plurality of pipes 19 extend through the body portion of the container 18 and serve to convey hot gases through this container, the gases being thus brought into heat exchanging relation through the coal being deposited in the hopper. The gases are supplied to these pipes through a pipe 20 which connects with the flues surrounding the preheating drum, and these gases are discharged through a pipe 21. A chute 9 at the base of the container 18 delivers the coal to the screw conveyor 10 which is operated by means of a motor 23 connected to the screw conveyor by means of belts or chains 24. The conveyor 10 is adapted to deliver the fuel to the interior of a preheating drum 25 which is caused to rotate by means of the gears 26 and 27, the latter of which is fixed to a shaft 28 driven by the motor 23. The gear 27 meshes with gear 26 which is fixed to one end of the preheating drum. The preheating drum 25 is enclosed within the heating chamber 26′ containing a number of baffles 27′ which cause the heating gases to circulate around the drums. The baffles 27′ form a series of flues within the heating chamber which are supplied with heating gases through a pipe 16 located near the discharge end of the drum 25. The gases are withdrawn from the preheating chamber through the pipe 20 which conducts them to the pipes 19 in the fuel hopper 2. Within the combustion chamber and between the discharge end of the pipe 16 and the discharge end of the drum 25 we have provided a gas burner 30 for heating the discharge end of the drum 25. A pipe 31 supplies gas to this burner and the rate at which this gas is supplied is controlled by an automatic temperature regulating device 32 having a thermocouple 33 which is responsive to the temperature of the fuel discharged from the preheating drum. We have not deemed it necessary to describe the details of this automatic temperature regulating device inasmuch as any suitable device of this type can be employed, such devices being in general commercial use. We prefer to employ some means for controlling the temperature of the fuel at the discharge end of the preheating drum, and we have found the automatic gas burner illustrated in Fig. 1 to be suitable for this purpose. This makes it possible to bring the coal up to a temperature within say 30° of that at which it would become plastic, and this is done in such a manner that there is no danger of the fuel being overheated.

A plurality of baffles or plates 34 are arranged within the discharge end of the drum 25 for the purpose of lifting the fuel and dropping it into a chute 35 where it comes in contact with the thermocouple 33 of the automatic regulating device. The fuel may be discharged from the chute 35 into the lorry 12 shown in Fig. 1 as described above.

We prefer to construct the preheating device so that the inclination of the drum 25 can be changed as desired. Accordingly we have illustrated a jack 36 resting on the floor 5 and engaging a column or support 37 which carries the end of the preheating device which receives the raw fuel. The discharge end of the preheating device is supported on the column 7 by means of a pivot joint 38, and it will be understood that the inclination of the drum 25 can be changed by simply raising or lowering the column or support 37 by means of the jack 36. In this way the rate at which the fuel travels through the rotating drum 25 can be carefully regulated. The rate at which the fuel passes through this drum can also be varied by changing the speed of the motor 23. Increasing the speed of the motor serves to increase the speed of the conveyor 10 as well as that of the drum 25, and the motor may be connected to the automatic regulating device 32 in any well known manner so as to cause the motor speed to change in accordance with changes in the temperature of the fuel discharged from the drum 25. The arrangement should be such that when the regulating device operates to supply more gas to the combustion chamber at the discharge end of the drum 25, the speed of the motor 23 will be decreased. Thus the combined effect of the gas burner and the motor will be to increase the temperature of the fuel at the discharge end of the drum 25.

A suitable valve 39 controls the flow of preheated fuel through the hopper or chute 11 which serves as a means for conveying the preheated fuel from the preheating drum 25 to the lorry or car 12. This lorry is mounted on a compound track or runway comprising a transverse portion 40 and a longitudinal portion 41. The lorry can be moved transversely, along the portion 40, suitable rollers 42 being provided for this purpose. The portion 40 carries rollers 43 which engage the track portion 41 so that the lorry can be moved along this track. We prefer to employ the lorry 12 and the parts associated therewith, or some equivalent device, adapted to supply the preheated fuel to any one of a plurality of coking retorts, although it will be understood that our invention can be used to advantage even where only a single retort is employed.

A gas and water vapor relief valve is shown at 11′.

We have found that considerable economy can be effected by employing a plurality of retorts for receiving the preheating fuel, the group or battery of retorts being supplied with preheated coal by a single preheating device such as the preheating drum 25 illustrated in Figs. 1, 3 and 4. An arrangement of retorts which we have found to be particularly satisfactory is illustrated in Figs. 1 and 5 to 9 inclusive. We have illustrated a battery of retorts comprising a number of vertical retorts 44 arranged in pairs, each pair being surrounded by heating flues. Each of the retorts 44 may be constructed out of a single piece of metal or other suitable material and we prefer to provide retorts which are of slightly greater diameter at the base than at the top, thus facilitating the removal of the coke charges from the retorts. It is not necessary to employ temperatures above say 750° C. and, accordingly, it is quite satisfactory to make the retorts out of any of the well-known heat resisting alloys. Each retort is provided with a hinged plate 44′ at the bottom thereof which can be swung downward to permit the coke to drop out. The plate 44′ may be perforated if desired. Mechanism for operating the hinged plates 44′ is shown at 45′ in Fig. 8. Suitable valves (not shown) are provided at the top of each retort for the purpose of permitting the preheated fuel to drop from the lorry 12 into the retorts and to close the retorts while the coking operation proceeds within the retorts. By maintaining the valves closed at the top of the retort for a short time after charging and allowing the gases to discharge through the perforated bottom 44′ the dust from the charging process is retained by the coal mass while the vapors pass out of the retort through the coke chamber and escape through the vent 74.

While heat may be supplied to the retorts in various ways, yet we prefer to employ the special heating system disclosed in the accompanying drawings. Upon referring to Figs. 5 to 9, inclusive, it will be noted that each retort 44 is surrounded by a heating chamber 45. One of the distinctive features of our improved heating system is the provision of means whereby heat is radiated to each of the retorts from the wall of the heating chamber surrounding each retort, heat being supplied to the chamber wall from the outside thereof. One or more gas mains such as those illustrated at 46 may be provided for the purpose of suppling gas to burners 47 located near the lower portions of the several retorts but separated therefrom by the heating chamber wall 48. These burners 47 are enclosed within flues which are adjacent to the exterior of the heating chamber walls 48 and these flues are enclosed by a heat insulating wall 49 which encloses the entire battery of retorts and heating chambers. Openings 50 are provided through the wall 49 for the purpose of permitting inspection of the burners 47 and to provide such access to the burners as is necessary to light them.

Our improved flue construction as illustrated in Figs. 5 to 9 inclusive, includes vertical passages 51 extending up from the burners 47 and communicating with adjacent vertical passages 52 extending down to the lower portions of the retorts where they communicate with the heating chambers surrounding the retort through short transverse passages 53. The hot flue gases thus pass up through the passages 51, down through the passages 52 through the short passages 53 and into direct contact with the retorts 44. Thus the hot gases come in contact with the exterior portions of the chamber walls 48 and do not come in contact with the retorts 44 until after they have passed up through the passages 51 and down through passages 52. In this way, the walls 48 are heated to a fairly high temperature and radiate heat to the retorts 44 in a substantially uniform manner throughout their length.

After the flue gases pass through the short passages 53 near the bottom portions of the retorts 44, they pass up around these retorts and escape through short passages 54 communicating with a manifold 55. This manifold 55 communicates with the pipe 16 which conveys the gases to the preheating device above described. This pipe 16 is provided with a flexible joint as shown at 16′, which permits elevation of the forward end of the preheating device without interfering with the supply of hot gases to the preheater.

We prefer to provide means whereby some of the hot gases supplied to the heating chambers 45 can be used for the purpose of supplying heat to the air admitted to the burners 47. Such a recuperator is illustrated in Figs. 5 to 9 inclusive. In these figures, we have illustrated small passages 56 leading from the upper portions of the heating chambers 45 into communication with vertical passages 57 leading downward and communicating with similar passages 58 leading upward to a manifold 59. The gases are discharged from the manifold 59 through a suitable pipe connection 17 as shown in Figs. 1 and 9. Valves 61 and 62 are provided in the pipes 17 and 16 for the purpose of regulating the relative amounts of flue gases passing through these portions of the system. The valve 61 may be closed entirely, in which case all of the flue gases pass up from the pipe 16 to the preheating device, or the valve 61 may be only partially closed, in which case some of the flue gases escape through the pipe 17. The air to which heat is supplied by the flue gases which ultimately pass out through pipe 17 is admitted to passages 63 near the base of the system as best shown in Fig. 7. The air flows upward through passages 64 and then downward through passages 65, through the horizontal passages 66 and 67 and through short vertical passages near each of the burners 47. In this way, the air supply to the burners is preheated by a portion of the flue gases which have previously come in contact with the retorts 44. Valves 68 control a supply of air to the passages 63 in the base of the recuperator. Similar valves 69 control the supply of air directly into the horizontal passages 66 from which it may flow to the burners 47. This air, which may be supplied either to the recuperator or directly to the burners, may, of course, be taken from the atmosphere immediately surrounding the battery of coking retorts but we prefer to supply some heat to the air before it reaches this point. One embodiment of such a means for preliminarily heating the air is described hereinafter.

The rate at which heat is supplied to the retorts 44 can be closely regulated by regulating the supply of gas to the burners 47. In this way, it is a relatively easy matter to supply to the retorts just enough heat to bring the preheated coal up to the temperature at which it commences to become plastic throughout; that is, to a temperature at which the exothermic reactions are initiated and proceed throughout the mass of fuel.

When the mass of coal in any one of the retorts 44 is completely coked, the hinged plate 44′ at the bottom of this retort can be released so as to permit the coke to drop down into a coke storage reservoir such as that illustrated at 14 in Figs. 1 and 10. The coke is allowed to cool down in this storage reservoir, below a red heat. In order that the heat given off by the coke during this cooling operation may be utilized, we prefer to provide a number of passages surrounding the coke storage chamber and through which air may be passed preliminary to supplying it to the gas burners 47. We have shown such passages at 70 in Figs. 1 and 10. The air may be drawn in through a suitable connection 71. It then passes in a circuitous path around the storage chamber to the base thereof and then back up and through a passage 72 which communicates with the valves 68 and 69 above described. These valves control the supply of air to the recuperator and to the passage which leads directly to the base of each burner 47.

We prefer to construct the coke storage chamber 14 with inclined walls so that the coke may be discharged into conveyor cars 15 through openings in the bottom of the storage chamber.

Our improved process of making coke can be carried out in a very economical manner by utilizing the apparatus above described. This apparatus is designed to utilize, to the best advantage, all of the heat which is ordinarily wasted during the process of converting coal into coke. The hot gases after leaving the retorts are conducted first to the preheating device and then to the flues extending through the hopper 2. Some of these gases may be brought into heat exchanging relation to the air which is being conducted to the burners near the base of each retort. Furthermore, the heat given off by the coke discharged from the retorts is utilized for the purpose of raising the temperature of the air which is to be supplied to the burners.

The raw coal is deposited in the hopper 2 where it receives some heat from the gases passing through the flues 19 in this hopper. The coal then passes into the rotating drum 25 where it is simultaneously tumbled and advanced while additional heat is being supplied thereto. The coal then passes into the chute 11 and from this chute it is discharged into the lorry 12. These two parts of the apparatus may be of large capacity so as to store a sufficient quantity of preheated fuel to fill several retorts. The lorry 12 can be moved into close proximity to any one of the retorts 44 for the purpose of discharging the preheated fuel into the retort. The final coking operation is performed within the retorts 44, the hydrocarbon vapors being withdrawn through pipes 73 shown in Fig. 1. The storage bin 14 communicates with the lower end of each of the retorts 44 and is adapted to receive the coke discharged from these retorts. The coke is ultimately discharged from the bin 14 into suitable receptacles such as the cars illustrated at 15 in Fig. 10.

A vent 74 is provided from the coke storage chamber 14, which connects with the gas conduits 75 leading from the retorts. This passageway permits of steaming the red hot coke for increasing the yield of gas and and ammonia and modifying the sulfur content. It is evident also that the gases which may escape around the loosely fitting bottom plates of retorts will find their way into these gas conduits. The necessity of securing a gas-tight fit between the swinging bottoms and the lower edge of the retorts is thus obviated.

It is to be understood that the various details of the process and apparatus above described can be modified and, in some instances, eliminated without departing from the spirit of our invention which is not limited to the particular embodiments illustrated and described but includes such modifications thereof as fall within the scope of the appended claims; for example, the preheating device is capable of use by itself for the purpose of heating material such as solid fuels of various kinds. The automatic regulation of the heat supplied to the fuel in the preheating device renders this device of value for many purposes.

We claim:

1. An apparatus for coking coal, comprising an inclined rotatable drum for tumbling and advancing the coal and having a discharge end, means for supplying heat to said drum to preheat the coal therein, a chute arranged near the discharge end of said drum and arranged to receive the preheated coal from said drum, a plurality of coking retorts, a movable lorry for receiving the preheated coal from said chute and means whereby said lorry can be moved close to any one of said retorts to discharge coal into the same.

2. An apparatus of the type described, comprising a coking retort, a chamber adapted to receive coke from the retort, a burner for supplying hot gases to the exterior of the retort, means for conveying air to the burner, said means being arranged to bring the air into heat exchanging relation to the coke in said chamber and to at least a portion of the gases which have previously been supplied to the exterior of said retort.

3. An apparatus of the type described, comprising means for receiving coal, means communicating therewith for agitating and advancing the coal, a retort for receiving the coal from said agitating means, means for supplying hot gases to the exterior of said retort, and means for conveying said gases from the exterior of said retort to the exterior of said agitating means and then into heat exchanging relation with the coal in said receiving means but out of contact with the coal in said receiving means whereby the fuel is progressively heated throughout and out of contact with the heating gases as it advances through the said receiving means and the agitating means.

4. An apparatus of the type described, comprising means for receiving coal at least one flue for conducting gases in heat exchanging relation with, but out of contact with, the interior of said receiving means, means communicating with said receiving means for agitating and advancing the coal, a retort for receiving the coal from said agitating means, burners for supplying hot gases to the exterior of said retort, means for supplying air to said burners, and means for conveying said gases from said retort into heat exchanging relation with the air being supplied to said burners and for then conducting the hot gases to the exterior of said agitating means and finally to the flue of said receiving means, whereby the fuel is progressively heated throughout and is maintained out of contact with the heating gases as it advances through the said receiving means and the agitating means.

5. An apparatus of the type described, comprising a coking retort, a burner for supplying hot gases to the exterior of said retort, means for supplying air to the burner and means for conducting the hot gases which have previously been supplied to the exterior of the retort into heat exchanging relation with the air being supplied to the burner.

6. An apparatus of the type described, comprising means for receiving coal, at least one flue for conducting gases in heat exchanging relation with the coal in said receiving means and out of contact with the coal therein, means communicating with said receiving means for agitating and advancing the coal, a retort for receiving the coal from said agitating means, means for supplying hot gases to the exterior of said retort out of contact with the coal therein, and means for conveying said gases from the exterior of said retort to the exterior of said agitating means and then to the flue of said receiving means, whereby the fuel is progressively heated throughout and out of contact with the heating gases as it advances through the said receiving means and the agitating means.

In testimony whereof we affix our signatures.

SAMUEL W. PARR.
THOMAS E. LAYNG.

April 18, 1950 G. E. EDLING **2,504,508**

MAGAZINE FURNACE AND METHOD OF BURNING FUEL
HAVING A LOW SINTERING TEMPERATURE
Filed Nov. 13, 1944

Fig. 1.

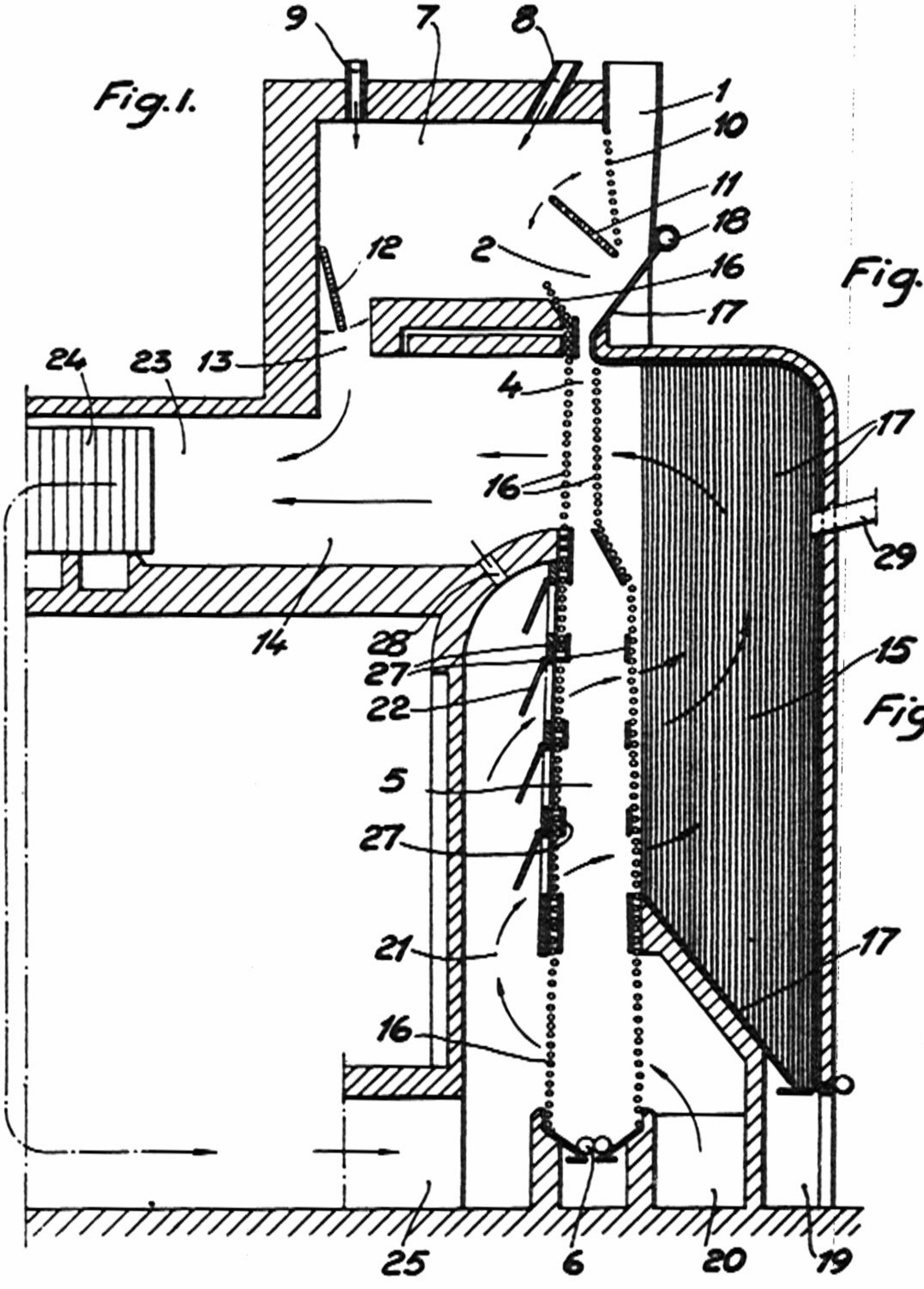


Fig. 2.

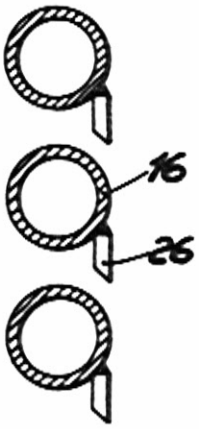
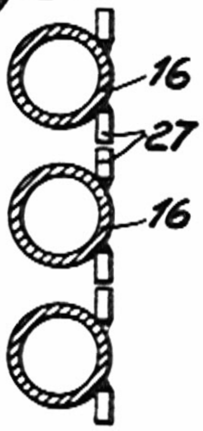


Fig. 3.



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Patented Apr. 18, 1950 2,504,508

UNITED STATES PATENT OFFICE

2,504,508

MAGAZINE FURNACE AND METHOD OF BURNING FUEL HAVING A LOW SINTERING TEMPERATURE

Gustaf Emanuel Edling, Stockholm, Sweden, assignor to David Dalin, Ostertalje, Sweden

Application November 13, 1944, Serial No. 563,299
In Sweden November 11, 1943

5 Claims. (Cl. 122—237)

(Granted under the provisions of sec. 14, act of March 2, 1927; 357 O. G. 5)

This invention relates to a method and device for producing heat carrying combustion gases and combustible gases from fuels of granular or other suitable shapes and sizes and has for its purpose accomplishing such combustion and gas generation with a high degree of efficiency and reliability. An important feature of this invention is that the fuel consisting of solid pieces of various sizes and shapes is made to burn and give off combustion gases and combustible gases while lying in a vertical or nearly vertical shaft having one or more walls, which are cooled in a suitable manner. The fuel is preferably piled to considerable height in the shaft, and the latter, in relation to its height, is comparatively narrow. Several advantages are gained by this arrangement, for instance, the combustion temperature can be effectively controlled by means of the cooled walls in the shaft and by using tubes which are filled with a flowing medium such as water or steam for the cooled walls, the excess heat of combustion can be usefully utilized, for instance, for the generation of steam and superheating of steam which in turn can be used for power generation. The invention can be used with advantage for all kinds of fuels, but is particularly valuable in devices for burning of waste products such as garbage and other burnable offal and for fuels with a low melting or sintering temperature such as coke remaining from shale and slate distillation and for burning or/and distillation of oleaginous shale.

In heretofore known furnaces for burning fuels containing ash which melts at a low temperature, considerable difficulties are experienced—because the temperature in the fuel bed, if an economically advantageous excess of combustion air is to be used for the combustion—gets so high that the ash melts and bakes together resulting in excessive slag and incomplete utilization of the fuel. By the use of the method and device of this invention, the above described disadvantages are eliminated and fuels having an ash with low melting or sintering temperature can be burnt with a high degree of utilization in, for instance, the generation of steam at such a temperature that the ash and slag will not melt. It is thus possible to effectively utilize such fuels and offal heretofore considered as waste.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a vertical sectional view through a combustion apparatus embodying this invention;

Figure 2 is a detail vertical sectional view on an enlarged scale through part of one wall of the fuel shaft, taken at one of its air inlets; and

Figure 3 is a detail view similar to Figure 2 illustrating another manner of restricting the air inlet openings between the tubes defining the walls of the shaft.

Referring now more particularly to the drawing, reference numeral 1 shows an infeed funnel for a solid crushed or granulated fuel, such as, shale coke, for example. At the lower end of this funnel the fuel assumes an exposed surface at 2 according to its angle of repose, from where it descends successively into the small upper part 4 of a vertical fuel shaft 5 which at its lower end is equipped with a suitable outfeed device 6 for the ash and slag. As is clearly shown on the drawing the shaft 4 and 5 is high but relatively narrow.

At one side of the funnel 1 there is a gas chamber 7 with air inlets 8 and 9. The part 10 of the funnel 1 which faces the gas chamber 7 is a cooled wall, preferably consisting of tubes through which flows a medium such as water or steam. The bottom of the tube wall 10 joins with a movable shutter 11 also constructed of tubes for water or steam, and a similar shutter 12, likewise made from similar tubes, is installed in the outlet opening 13 leading from the gas chamber 7 to the main combustion chamber 14, 15.

The shaft 4, 5 has similar cooled walls which preferably are made from tubes 16 which are filled with a flowing medium (water or steam) and connected to headers (water or steam chests) or the like (not shown).

In Figures 2 and 3 it is clearly shown that there is a considerable distance between the tubes 16. These tubes are like the tubes 10 shown horizontally disposed, but vertical or slanting tubes or tubes with other configuration can also be used.

The walls in the combustion chamber 15 are also covered with water or steam tubes 17 or cooled by other means. On the drawing the tubes 17 are shown vertically disposed and connected to headers 18. From the space 19 located below the combustion chamber 15 collected soot and ash can be readily removed.

Combustion air is admitted through the passage 20 from a fan, for example, and flows through and across the lower part of the shaft 5, which is filled with ash or slag, into the distribution chamber 21. From this chamber 21 the air flows through openings regulated by the shutters 22 through and across the shaft 5 approximately in a horizontal direction and out into the chamber 15. The combustion gases rise upwards in this chamber and pass thereafter through and across the narrowest part of the shaft 4 into the chamber 14 and from there through the passage 23 to a steam boiler 24 or other heat exchanger. Chamber 21 is further equipped with an inlet 25 for admittance of gases, for example combustion gases or water vapors, for the purpose of diluting the combustion air and thereby modifying the intensity of the combustion gases. By means of a fan or the like, the passage 25 may be connected with the combustion gas outlet from the steam boiler 24, so that a part of the escaping combustion gases are led through the passage 25 and thus made to circulate through the whole combustion device.

At the openings opposite the shutters 22 the tubes 16 are equipped with flanges 26 or similar protuberances in a manner shown in Figure 2. These flanges 26 can be directly welded to the tubes 16 and be so shaped that they prevent the fuel from falling out between the tubes 16 but allow the combustion air to pass. The spaces between the shutter openings have the tubes 16 covered by plates 27 which are welded to or in other suitable manner attached to the tubes as shown in Figure 3, for the purpose of preventing the air from passing through the zones thus covered. By this means the air stream is forced to flow from the distribution chamber 21 to the chamber 15 in a more or less horizontal direction across and through the fuel shaft 5.

An air inlet opening 28 connects the distributing chamber 21 to chamber 14, which can have one or more inlet openings 29 for secondary air, in case combustion is to take place in said chamber.

In a device as above described the fuel is fed into the shaft through the funnel 1. Through radiation from the gas chamber 7 the fuel is preheated so that such volatile gases that are contained in the fuel wholly or partly are made to escape into the chamber 7 where they may be burnt if desirable for completing the combustion process. This part of the combustion is regulated by adjusting the cooled shutters 11, 12 in various positions and furthermore in the usual manner by regulating the combustion air coming through the inlets 8 and 9. The shutter 11 is thus adjusted to such a position that the temperature of the fuel does not rise above the most desirable degree having in mind the nature of the fuel and the purpose of the process. By means of the shutter 12 the flow of the gases from the chamber 7 to chamber 14 is regulated. In some cases it is desirable to admit a certain regulated quantity of secondary air to the chamber 14 for example through the opening 28 in order to there burn the gases from the chamber 7.

If the fuel at 2 is directly exposed to the radiation from the burning gases or to radiation from the surrounding brick-work in chamber 7, the gases escaping from the fuel in the funnel 1 will also be consumed by combustion.

After the fuel has thus been preheated and degassed it passes downwards into the shaft 4 and 5 and is successively burnt. In the lower part of the shaft the ashes and slag are removed through the outfeed apparatus 6. By regulating the speed of the outfeed device the speed with which the fuel moves downwards through the shaft 4 and 5 can be easily and effectively regulated.

The combustion air, either cold or preheated, coming through the passage 20 passes first through the ash chamber in the lower part of the shaft 5, thereby cooling the ashes or slag while being itself heated. The thus heated combustion air after having passed through the ash chamber into the distributing chamber 21 passes through the openings at shutters 22 across and through section 5 of the shaft to effect combustion of the fuel contained in shaft 5. If complete combustion is desired, the final combustion will take place in the chambers 15 and 14, whereby if required the necessary amount of secondary air will be added through the inlet opening 28 and another opening 29. The combustion gases resulting from the combustion in the shaft 5 pass into chamber 15 and from there through and across part 4 of the shaft, whereby they dry and heat (eventually also ignite) the downwardly slowly moving fuel. If the device is used for steam generation the combustion gases can pass through the channel 23 to the steam boiler 24. If the device, on the other hand, is used as a gas generator, the gas escapes through the channel 23 for further use in other devices (not shown).

In certain cases it is desirable to let only a part of the gases pass through the upper part 4 of the shaft. The remaining part of the gases is then led in another direction, for example direct to a steam boiler (not shown).

If the fuel contains a great deal of moisture it may be desirable to conduct the drying of the material in the upper part 4 of the shaft in such a manner, that the temperature of the gases after having passed through shaft 4 is so low that further cooling (utilization of the remaining heat in the gas) is economically unprofitable.

The combustion in the fuel shaft 4 and 5 occurs while the fuel is in more or less direct contact with the cool-walls of the shaft, that is with the tubes 16. The fuel is therefore subjected to the cooling effect from these walls while the combustion takes place and by this means it is possible to control and regulate the temperature of the fuel bed as desired. If, for instance, the fuel consists of coke from oleaginous shale or other similar fuels having an ash with low melting or sintering temperature, the cooling effect is regulated in such a manner that the ash will not melt and cause the fuel to cake together, thus allowing a complete and uninterrupted combustion of the fuel. A further regulation of the combustion temperature is possible by diluting the combustion air with some suitable gas such as spent combustion gases or water vapors which are admitted through the passage 25. If in this manner combustion gas containing a high percentage of carbon dioxide (CO_2) is admitted to the channel 25 the carbon dioxide is broken down to carbon monoxide (CO) in the shaft 5, thereby consuming heat with a resulting lowering of the temperature in the shaft. Breaking down of the water takes place in a similar manner, if water vapor instead is admitted through the passage 25. It is even possible to admit, through the passage, only an inert gas such as nitrogen for direct dilution of the combustion air, so that the combustion intensity and thereby also the temperature in the shaft 5 is reduced. A portion of the combustion gases from the steam boiler 24 can also eventually be returned by means of a fan to the passage 25 so that these combustion gases circulate within the apparatus and only receive so much addition of fresh combustion air from the passage 20 which corresponds to the combustion's requirement of oxygen. From the above it will readily be seen that the combustion in the shaft 5 can easily be regulated in desired manner.

This regulation of the combustion results in a high utilization of the fuel and a very efficient combustion process. This result is largely due to the fact that the burning of the fuel can proceed uninterrupted without the formation of large cakes of slag and because the heat transmission from the fuel in combustion to the tubes 16, 17, 10—12 is very effective, whereby the flowing medium in the tubes, preferably water or steam, is effectively heated. The tube systems 10, 12, 16, 17 can therefore with advantage be used for steam production or for steam superheating.

Certain modifications in the above shown and described device can easily be made within the scope of this invention. For instance the walls in the shaft 4, 5 or in the combustion chamber 15 can be cooled by other means than by tubes. One or more walls in the fuel shaft 4, 5 may be cooled but preferably all walls should be cooled. The gas chamber 7 may be entirely eliminated. In the chamber 15 a convected heating surface may be installed.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A combustion apparatus especially adapted for the burning of fuels having low sintering temperatures comprising: means defining an upright fuel shaft in which the fuel is held during combustion thereof, said means including fluid cooled surfaces defining opposite walls of said shaft, said surfaces having air spaces therebetween through which air may flow into and out of the shaft; means defining a combustion chamber at one side of said shaft and with which the shaft interior connects through the air spaces in the adjacent shaft wall; means defining an air distributing chamber at the opposite side of the shaft, said air distributing chamber being connected with the shaft interior through the air spaces in the adjacent wall of the shaft and terminating short of the top of the combustion chamber; means defining an exhaust flue above the air distributing chamber, said exhaust flue having communication with the top of the combustion chamber and the interior of the upper portion of the shaft through the air spaces in its opposite walls; means defining an inlet for combustion air, said inlet leading to the lower portion of the shaft at the side thereof remote from the air distributing chamber so that the combustion air must pass through the lower portion of the shaft to reach the distributing chamber; and means for deflecting combustion air rising within the distributing chamber laterally through the shaft and into the combustion chamber for subsequent passage to the exhaust flue.

2. The hereindescribed method of burning fuel having a low sintering temperature, in a furnace having a well defined fuel passage leading from a fuel inlet to a grate; and having fluid ducts in juxtaposition to the fuel passage and at such relative spacing that all portions of the burning fuel are close to some part of the ducts, which comprises: feeding fuel of low sintering temperature to the fuel passage; igniting the fuel so as to cause the same to burn in the combustion zone above the grate; supplying combustion air to the fuel in said zone in such volume as to

maintain a high rate of combustion; continuing the feeding of fuel to the fuel passage as the fuel burns away; and circulating a fluid coolant through the fluid ducts in such volume as to keep all portions of the burning fuel at a temperature below the sintering point of the fuel.

3. The hereindescribed method of degassing and subsequently burning fuel having a low sintering temperature in a furnace having a well defined vertical fuel passage leading from a fuel inlet at its top, through a degassing zone and a combustion zone above a grate; and having tubular fluid ducts in juxtaposition to the combustion zone of the fuel passage and at such relative spacing that all portions of the burning fuel are close to some part of the ducts, which comprises feeding fuel of low sintering temperature into the fuel passage through its inlet to pass through the degassing zone to the combustion zone; igniting the fuel in the combustion zone above the grate to cause the same to burn and provide heat for driving of gases from the fuel in the degassing zone; drawing off the gases released from the fuel in the degassing zone; supplying combustion air to the fuel in the combustion zone in such volume as to maintain a high rate of combustion; continuing the feeding of fuel to the fuel passage through its inlet as the fuel burns away; and circulating a fluid coolant through the tubular fluid ducts in such volume as to keep all portions of the burning fuel at a temperature below the sintering point of the fuel.

4. In the process of burning fuel having a low sintering temperature, the step of circulating fluid heat absorbing medium in juxtaposition to, but not in contact with, fuel in the zone of combustion in sufficient volume and quantity to maintain the temperature of the fuel in said zone below the sintering temperature thereof.

5. The method of burning fuel having a low sintering temperature, which comprises: confining the fuel to a defined zone for combustion; supplying air to the fuel in said zone in such quantity as to assure optimum conditions for rapid combustion of the fuel; circulating a fluid coolant along defined paths in juxtaposition to, but not in contact with the fuel within, the combustion zone to carry off heat energy from the burning fuel; and so regulating the flow and quantity of the fluid coolant as to assure the dissipation of enough heat energy from the burning fuel to preclude sintering of the fuel.

GUSTAF EMANUEL EDLING.

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BRIEF FOR APPELLANT

In The

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA

DAVID DALIN,
Plaintiff-Appellant,
v.
ROBERT C. WATSON
~~JOHN A. MARZA~~LL,
Commissioner of Patents,
Defendant-Appellee.

Appeal
No. 11,479

Appeal from Judgment of the
District Court for the District of Columbia

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United States Court of Appeals
For the
District of Columbia Circuit
FILED OCT 10 1952
Joseph W. Stewart
CLERK

In The

United States Court of Appeals

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BRIEF FOR APPELLANT

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In The

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Commissioner of Patents,
Defendant-Appellee.

Appeal
No. 11,479

BRIEF FOR APPELLANT

JURISDICTIONAL STATEMENT

This appeal arises in an action for the issuance of a patent brought against the Commissioner of Patents under R.S. 4915, 35 U.S.C. Sec. 63. The Complaint sets forth (App. 2)[1] that plaintiff David Dalin is a subject of the King of Sweden and resides in the Kingdom of Sweden, and consequently this action was brought in the District Court for the District of Columbia under 44 Stat. 1394, 35 U.S.C. Sec. 72a. The inventors named in the application are said David Dalin and Tore Johannes Hedbäck (also a subject of the King of Sweden, residing in Sweden), and said Hedbäck has assigned his entire right, title and interest in the application, in writing, to Dalin. (App. 2)

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[1] The parties have prepared a joint appendix, and references thereto will be designated by "App." followed by the page number.

Final judgment for the Commissioner of Patents was entered in the District Court on March 31, 1952 (App. 62), and this appeal was taken on May 27, 1952 under the provisions of Rule 73(a), Federal Rules of Civil Procedure. This Court has jurisdiction of the appeal under 28 U.S.C. Secs. 1291 and 1294.

STATEMENT OF THE CASE

All of the claims in plaintiff's application in issue were rejected by the Patent Office Examiner, and upon appeal to the Patent Office Board of Appeals the Examiner's rejection was affirmed. (App. 80-83) This action was thereupon timely brought in the District Court for the District of Columbia. After trial on the merits the court below gave judgment for defendant, the Commissioner of Patents (App. 61-62), in effect sustaining the Patent Office in its rejection, and plaintiff brings this appeal.

Historical Background of the Application

The invention of this application relates to the destructive distillation[1] of solid fuels having a low sintering temperature. Such fuels include a rather wide range of compounds, such as shale, coal, slate and oil bearing shale, in pieces of various sizes and shapes.

---

[1] Destructive distillation is the process of heating solid material out of the presence of oxygen to drive out gaseous components therein, and collecting the volatile products evolved. Because the volatiles are driven off as gases, the process is also known as "degassing" and will sometimes be so referred to herein. The gases so driven off may be wholly or partly recondensed into liquid oils. The destructive distillation of shale yields oil from which such commercially valuable hydrocarbons as gasoline and fuel oil may be produced by refining.

In order to understand the applicants' invention and its significance, it is necessary to know that fuels of the type here under consideration contain a non-combustible component which sinters (i.e., melts or plasticizes) at temperatures well within the range at which efficient distillation and combustion of such fuels take place. When the material begins to melt or plasticize under the influence of such temperatures, a glassy surface forms on the individual pieces which seals in the volatile hydrocarbons and prevents their being driven off during distillation of the material and of course prevents them from being burned when the material is combusted. Moreover, when sintering occurs during combustion, the individual pieces of fuel in the bed tend to fuse into a solid mass which is impenetrable to the air necessary to sustain combustion. (App. 33-34) This mass, once it begins to form, is difficult to break up, and when cooled resembles an ordinary furnace clinker. (App. 52)

The temperature at which plasticization or sintering begins to occur in shale and similar bitumens is below the temperature which would normally result from combusting such fuel at an optimum rate. Moreover, it is important to observe that sintering will occur in fuel being degassed out of the presence of oxygen if the temperature of such fuel is permitted to go above the sintering point.

While it had long been known that sintering must be avoided in the distillation and combustion of fuels of the type here under consideration, the discovery of an efficient means of preventing it had eluded those skilled in the art. Prior to about 1943 only three methods of controlling sintering were known (App. 29): (1) regulating the through-put, i.e., rapidity or rate at which the shale being processed is fed through the apparatus; (2) feeding a greater or lesser excess of combustion air to fuel being burned; and (3) injecting steam into the combustion zone. (App. 29, 52)

None of these expedients was satisfactory. Controlling the through-put of shale was objectionable since this achieved control of sintering at the expense of maximum production capacity and efficiency. Feeding an excess of combustion air to the fuel bed, in order to carry off and dissipate some of the heat and thereby keep the combustion temperature below the sintering point of the fuel, is obviously wasteful. (App. 43-44) The third expedient, introduction of live steam[1] into the combusting fuel bed, likewise tends to carry away heat by diluting the combustion gases, and is, for the same reason, inefficient; and moreover it was somewhat less effective as a means of preventing sintering than was the use of excessive amounts of combustion air. (App. 30)

It is interesting to note that the problem of sintering, so far as it is involved in the destructive distillation of oil bearing shale at least, was not of any great commercial concern in the United States until recent years, when an experimental plant was constructed at Rifle, Colorado, by the United States Government for the production of gasoline from Colorado shale. (Transcript of Trial Proceedings, p. 62) Sweden, however, has been very much concerned with this problem because its only source of oil comprises certain shale deposits. (App. 36-37)

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[1] Live steam was used because it is an inert gas and thus does not react in the combustion process—and of course is readily available.

Both the important prior art reference patent to Bergh, No. 1,618,566 (App. 85-88), and the invention of the application here involved, grew out of the Swedish Government's vital interest in perfecting a method of processing the oil bearing shale from these deposits in a manner which would recover a maximum of their useful volatile components at a minimum cost. Hence the nature of the invention, as well as the nature and teachings of the principal prior art reference, are best understood in the light of the history of this development.[1]

In 1924 the Swedish Marine Department commissioned Sven Vilhelm Bergh, patentee of the reference patent No. 1,618,566, to install a plant at Kinne-Kleva, Sweden, for the processing of the shale found in huge quantities in that neighborhood. Shortly after the outbreak of World War II, a second and much larger Bergh plant was constructed at Kinne-Kleva which was similar to the first in all material respects. (App. 19-20)

Both of these Bergh plants at Kinne-Kleva were built in close accordance with the disclosure in the reference patent to Bergh, No. 1,618,566. (App. 85) Each unit of the plants comprised a furnace block 2 constructed of brick, with several distillation vessels or retorts suspended inside the furnace block in a cell-like arrangement. Shale to be processed was introduced into the top of each retort and caused to pass downwardly therethrough, being heated, in the course of its descent, by hot combustion gases passing upwardly in the furnace block along the outside of the retort. This heating of the shale drove off its volatile constituents, which were collected and drawn out of the retort by a duct 6 opening to the interior of the retort near the bottom thereof.

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[1] This history was not before the Patent Office in the form of evidence of which it could take cognizance, having been presented informally in a brief before the Board of Appeals. Note the second paragraph of the Examiner's Reply to Brief at App. 78.

The retorts extended only partway to the bottom of the furnace block, and each retort opened at its bottom to a pair of combustion chambers 9[1] into which the degassed fuel passed and in which it was supposed to be completely combusted, the hot combustion gases passing up along the retort to supply the heat for the distillation process and being vented through a stack. The fuel leaving the retort filled the combustion chambers 9 to form a bed which moved continuously downwardly to, and through, grates 20, 21, whence it emptied into an ash pit. The bulk of this bed was ash, with combustion occurring in only a relatively shallow surface layer. (App. 47)

The two combustion chambers 9, below each retort, were separated by a wall 19, the top of which was spaced from the bottom of the retort. The purpose of this wall is not clear, but apparently it was intended to divide the fuel residue into two streams so that it could be more readily discharged through the grates. (App. 40) Extending along the top of each wall was a bar 15, "which preferably is constructed hollow and provided with an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool the bar". (App. 87, lines 82-85)

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[1] Although the chambers 9 are referred to as "combustion chambers" in the Bergh patent, the term is not strictly accurate, since combustion occurs only at the surface of the fuel which they contain. (App. 47, 58-59)

The bar 15 in Bergh poses one of the crucial issues in this case.[1] The purpose of this bar is not specified in the patent,[2] but the witness Prof. Christie regarded it "as a splitter device to divide the stream of shale between the two pits 9 and 9". (App. 53) This conclusion is supported by the fact that the patent drawing shows an inverted angle, a sort of cap, over each bar 15, and the Bergh patent application as originally filed showed linkage mechanism for rocking the bar on its axis. For some reason this linkage mechanism was deleted from the drawing by amendment during prosecution of the Bergh patent, and all reference thereto was erased from the specification, but some vestige of it, in the form of a lever designated 23, remains in the drawing. (App. 13-14, Dalin's Exhibit 7)[3] The rocking motion of the bar imparted by this linkage, together with its non-circular cross-section, were undoubtedly intended to disturb or agitate the fuel bed during its combustion. (App. 53)

Although a major issue in this case turns upon Bergh's intent and purpose in providing the bar 15, that bar, and the partition wall 19 immediately beneath it, proved to be worse than useless in the operation of the Bergh plant at Kinne-Kleva, and both were subsequently removed, with an actual increase in the efficiency of operation of the plant. (App. 22, 23, 26, 31, 32-33)

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[1] Cf. the following at pp. 112-113, Transcript of Trial Proceedings:

> The Court: Is it your position that if this bar 15 had not been mentioned in the Bergh patent you would have no trouble at all?
>
> Mr. Jones. None at all, your honor * * *.
>
> The Court: As I see it, the issue is pretty narrow in this case.

[2] An ambiguous sentence in the Bergh specification has been construed to relate to the bar 15. The controversy in this case centers around the interpretation of that sentence, which is discussed at length hereinafter at p. 22 et seq.

[3] The Swedish Bergh patent which is the counterpart of the U. S. Bergh reference patent states that this bar "can either be fixed or given a rocking movement. (App. 33)

The problem of sintering was a serious one in the Bergh units, but the only means used in an attempt to control it was the old expedient of supplying an excess of combustion air and regulating throughput. This resulted in inefficient operation (App. 20) without however satisfactorily preventing sintering, which still created a great deal of difficulty. (App. 22)

Although the Bergh units at Kinne-Kleva were by no means satisfactory, they were apparently the best that was known in Sweden. In 1942 the Swedish Government arranged for the installation of a shale processing plant at Kvarntorp, where shale of slightly higher oil content than that at Kinne-Kleva was found. Some of the units of the Kvarntorp plant were substantially identical with the Bergh units at Kinne-Kleva, but because of the inefficiency of the Bergh apparatus other units were installed at Kvarntorp, at about the same time, in which the heat for the distillation process was supplied from a source other than the degassed shale, and the shale residue was dumped onto piles immediately after it emerged from the retort. Since this residue was self-igniting it smouldered and emitted sulfur fumes which destroyed vegetation for miles around. (App. 20-21)

At this point the management of the Kvarntorp plant, greatly concerned about the problem created by the sulfur fumes, called upon David Dalin, the plaintiff and a co-inventor of the application in suit. (App. 21) Mr. Dalin realized that the situation at Kvarntorp was ultimately traceable to the problem of sintering, especially the sintering which took place in the combustion zone, and suggested that the temperature of the fuel mass in it as well as in the distillation zone might be held to a value below that at which the fuel sintered by circulating fluid heat absorbing medium throughout the entire fuel mass in heat exchange relation thereto, but not in contact therewith. (App. 21) In a general way this principle is utilized in the reference patent to Edling, No. 2,504,508. (App. 113-117) Ultimately Dalin's suggestion was embodied in a small pilot plant at Kvarntorp, and the success of that unit led to the construction there of a small commercial plant capable of processing 150 tons of coke per day. (App. 21) In 1945 the commercial plant at Kvarntorp was enlarged to increase its capacity to 1,500 tons of coke per day. (App. 21-22)

Next, experiments were begun with the Bergh units at Kvarntorp with a view to improving their efficiency. Even before Mr. Dalin entered the picture the management of the Kvarntorp plant had removed from the Bergh units the bar and wall identified in the Bergh patent by 15 and 19, respectively, with a resulting gain in efficiency. (App. 23) Following the teachings of the invention here involved, cooling ducts were installed (over the strenuous objections of Bergh himself) adjacent to the lower end of the retort for the purpose of absorbing heat from the burning fuel mass in that area to thereby effect control over sintering. (App. 23-24) Even before all adjustments were made and personnel were adequately trained in the operation of the remodeled plant, tests showed a tremendous increase in efficiency, amounting to at least 200%. (App. 24) Thereupon the Swedish Government ordered the Kvarntorp management to install cooling ducts in all of the Bergh units, and they were accordingly remodeled to embody in them the basic principle of the Dalin and Hedbäck invention here in issue. (App. 24) Again a tremendous increase in efficiency resulted. (App. 24-25)

The Application in Suit

The Dalin and Hedbäck application in suit discloses and claims structure which was embodied in principle in the rebuilt Bergh units and which resulted in such remarkable improvement in their efficiency. This structure may be most readily understood by reference to the accompanying chart, the original of which is in evidence as "Plaintiff's Exhibit 5".

As in the Bergh device, the retort in which degassing occurs is suspended in a furnace or combustion shaft (colored yellow) in which fuel may be burned to provide heat for the process. The retort itself (colored green) does not empty directly into the combustion shaft at its bottom, as in Bergh, but has a screw conveyor at its lower end which carries the degassed fuel to an elevator (indicated by dot-dash lines at the righthand side of Figure 2 of the chart) by which it is lifted back up to the top of the furnace block. While still hot, the fuel is dropped down into the combustion zone, which is alongside the retort, rather than below it as in Bergh, to build up in columns embedding a substantial portion of the retort at opposite sides thereof. Grates located near the bottom of the retort support these columns of fuel, and combustion air is fed to the fuel in the shaft from ports at about the level of the grates to sustain combustion of fuel in the shaft throughout the entire height of the columns thereof. The fuel moves down through the combustion zone, and, when all of its combustible elements have been consumed, falls through the grates into an ash pit. The process is of course a continuous one.

CLARIFIED ILLUSTRATION OF APPLICATION STRUCTURE

MAIN CLAIM 23

In a device for the dry distillation of materials:

1. an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation;

2. an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft,

   (a) said retort being adapted to contain material to be distilled by the heat of combustion in the shaft; and

3. means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place,

   (a) said means comprising a network of ducts through which a heat absorbing fluid circulates

   (b) certain of said ducts being embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft,

   (c) and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort.

Fig. 1.

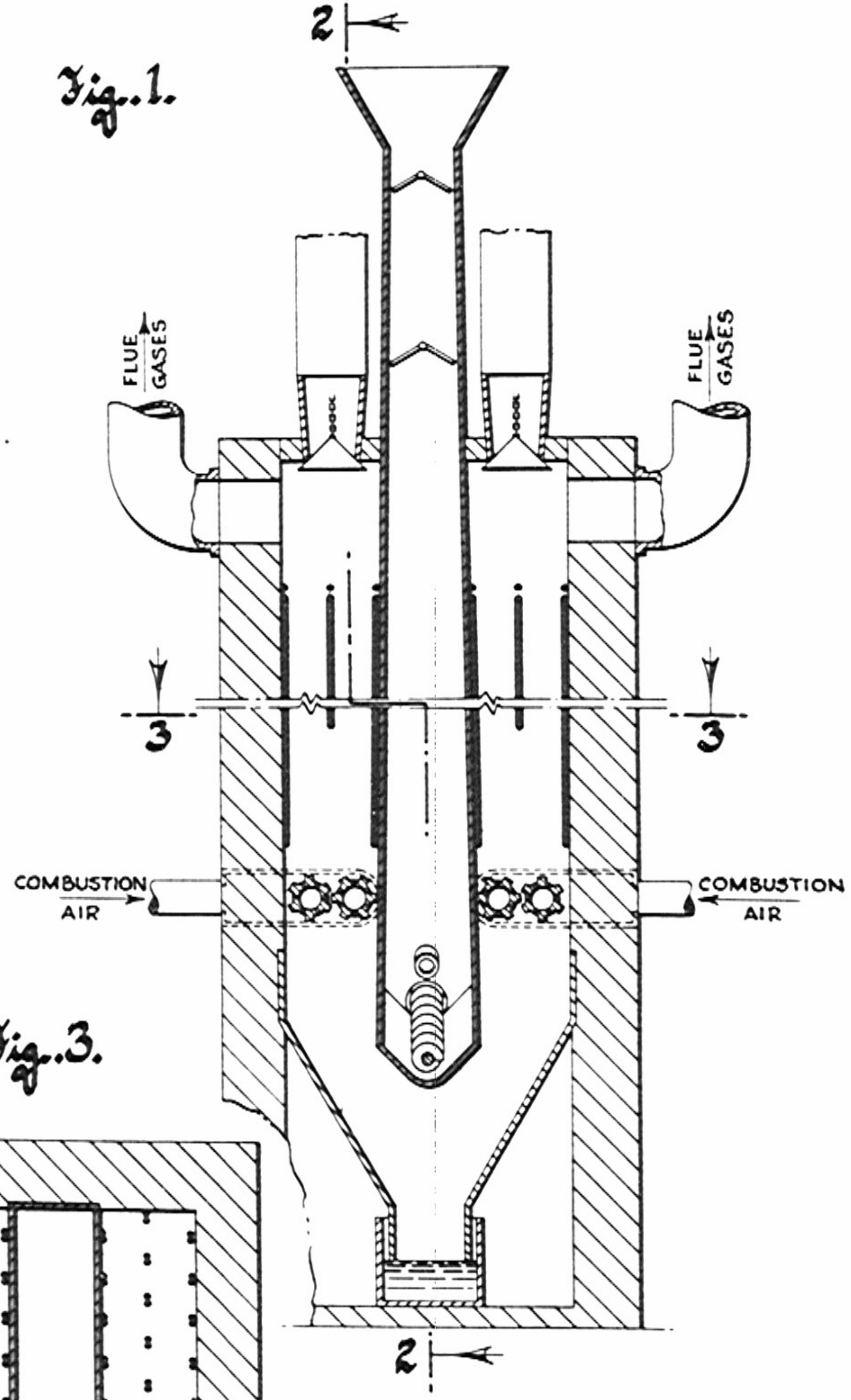


Fig. 2.

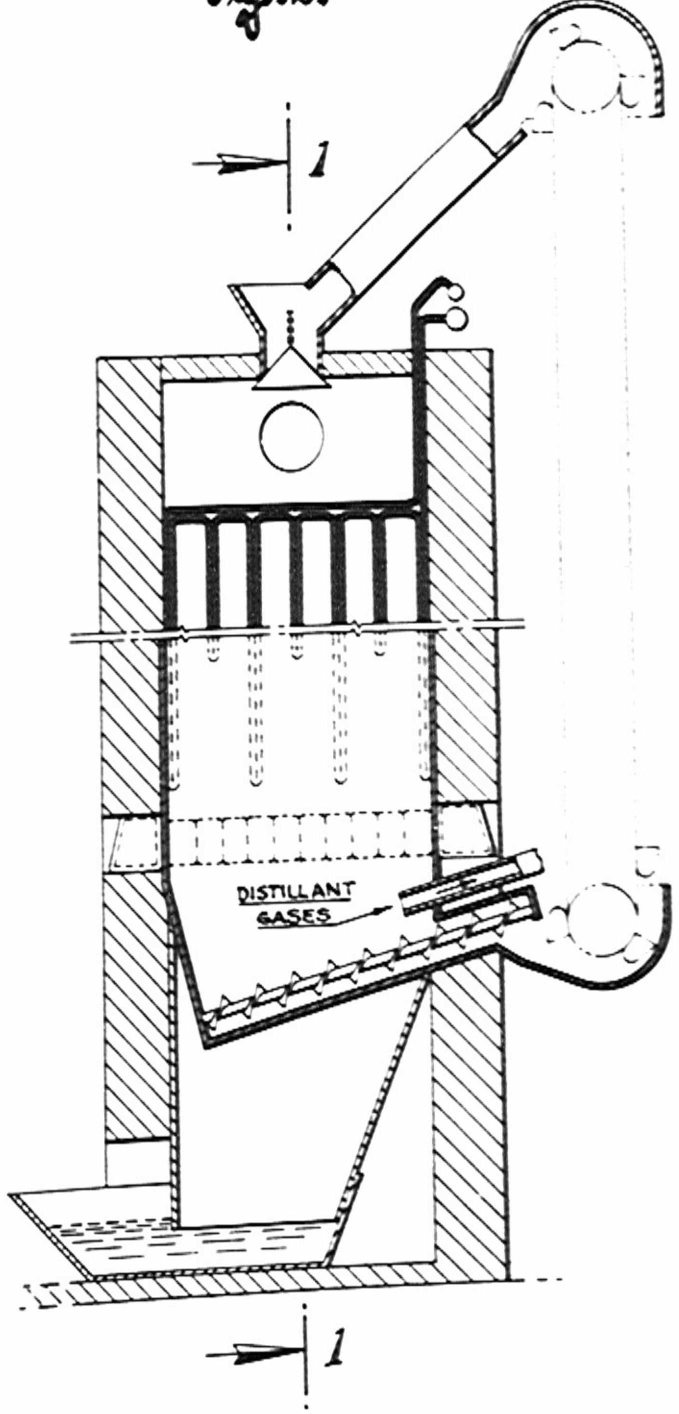
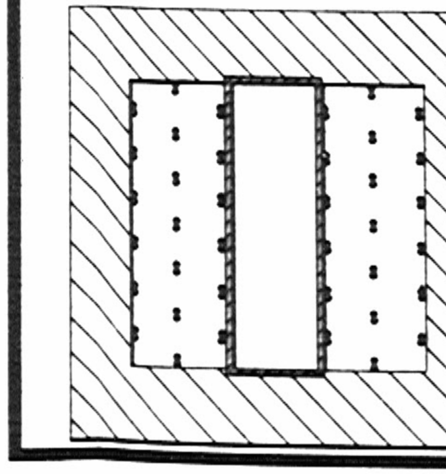


Fig. 3.



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It is true that claim 23, the illustrative claim of the application analyzed on the accompanying chart,[1] does not specify the screw conveyor and elevator, or their equivalents. However, the claim requires the retort to have at least its lower portion "embedded in the fuel in the shaft", whereas the record shows without contradiction that it is impossible for combusting fuel in the Bergh apparatus to build up above the level of the bottom of the retort. (App. 59)

The major distinction between the structure of the instant application and that of the reference Bergh patent resides in the provision of a highly efficient as well as completely effective means for controlling sintering of the fuel in both the combustion and distillation zones, namely (as brought out in claim 23) the provision of "a network of ducts through which a heat absorbing fluid circulates". Certain of these ducts are "embedded in the fuel in the [combustion] shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulated through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft;" while the remainder of the ducts are arranged in juxtaposition to the walls of that portion of the retort which is embedded in the combusting fuel in the retort.

Decision of the Court Below

The opinion of the District Court, holding that plaintiffs are not entitled to a patent, mentions only the Bergh patent, and the crux of the opinion—indeed, the entire reasoning of the court—is contained in a single sentence:

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[1] Claim 23 is the dominant claim in the application, all others being dependent thereon. Moreover, the parties agreed that "If claim 23 falls, the rest of them fall, too" (colloquy at App. 60).

> "It seems to the Court that the claims in the pending application do not define structures which are patentably distinct from those of the Bergh patent." (App. 61)

The court below also made findings of fact holding that the claims of the instant application do not define invention "over the Bergh patent disclosure", "over the Bergh patent in view of Edling" and "over the Bergh patent in view of the prior art." (App. 64)

STATUTES, TREATIES, REGULATIONS OR RULES INVOLVED

The issue in this appeal is one of fact and does not involve the interpretation of any statute, treaty, regulation or rule.

PROPOSITIONS OF LAW RELIED UPON

The description in the prior art patent must be tested by the knowledge of persons skilled in the art as it existed at the date of the prior patent.

> *Bowers v. San Francisco Bridge Co.,* 91 Fed. 381 @ 410 (C.C., N.D. Cal., 1898)

A patent relied upon as an anticipation must itself speak. Its specification must give in substance the same knowledge and the same directions as the specification of the patent in suit.

> *Skelly Oil Co. v. Universal Oil Products Co.,* 31 F. (2d) 427 @ 431 (C.C.A.-3, 1929)

The law is not friendly to efforts to spell out a later invention in the light of what it has itself disclosed.

> *Permutit Co. v. Paige and Jones Chemical Co.,* 292 Fed. 239 @ 241 (D.C., S.D., N.Y., 1923; mod. on another point, 22 F. (2d) 916)

Invention cannot be defeated merely by showing that in one form or another each element was known or used before. The question is, did anyone before think of combining the elements in this manner to achieve the particular unitary result — a new function? If not there is invention.

> *Pointer v. Six Wheel Corp.,* 177 F. (2d) 153 @ 160 (C.A.-9, 1949)
>
> *Gordon Form Lathe Co. v. Walcott Machine Co.,* 32 F. (2d) 55 @ 58 (C.C.A.-6, 1929)

The mere accidental use in a prior art patent of some of the features of an invention without recognition of their benefits does not constitute anticipation.

> *Bernitz Furnace Appliance Co. v. Wilson,* 79 F. (2d) 442 @ 444 (C.C.A.-3, 1935)

The fact that a prior art device, even though adaptable to the purpose for which the structure is used by the applicant for a patent, was not in fact adapted for that purpose strongly indicates that the changes necessary for that adaptation were not obvious and involved more than mere mechanical skill.

> *Trabon Engineering Corp. v. Dirkes,* 136 F. (2d) 24 @ 26 (C.C.A.-6, 1943)

In considering prior patents as anticipations it is not permissible to modify the structures disclosed by such patents and then claim the modified structures as anticipations.

> *Diamond Power Specialty Corp. v. Bayer,* 13 F. (2d) 337 @ 341 (C.C.A.-8, 1926)

OUTLINE OF ARGUMENT

1. Since the decision of the court below is predicated upon the Bergh patent, it is only necessary to show that the Bergh patent does not contain the teaching which the District Court found therein to warrant reversal of its judgment.

2. Finding No. 6 is in error because:

   a. It is physically impossible for Bergh's retort to be embedded in burning fuel.

   b. Applicants achieved an entirely new and unexpected result by embedding a portion of their retort in burning fuel—a deepening of the combustion and distillation zones which would have been inconceivable to Bergh.

3. Finding No. 7 is in error because the steaming coils and superheaters in the upper portions of Bergh's shaft can in nowise regulate temperature in the combustion zone, nor can they influence temperature in the hottest part of the distillation zone.

4. Crucial Finding No. 8 is in error because:

   a. The slight cooling influence exerted by Bergh's bar 15 upon the fuel immediately surrounding it can in nowise be said to be a regulation of temperature in the combustion zone such as would be required to control sintering.

   b. The Bergh patent says nothing about the cooling influence of the bar 15 upon the *combustion zone* and makes it clear that the bar was intended to function as a *bar*.

   c. The District Court interpolated into the Bergh patent an intent to use the bar 15 for its cooling effect, which intent could only have been derived by hindsight from the teachings of applicants' invention, as demonstrated by the discrepancy between the language of the Bergh patent and that of Finding No. 8.

d. The record shows without contradiction or challenge that men of outstanding skill in the art could not learn from the Bergh patent what the District Court found therein.

e. Even Bergh could not learn from his own patent the teaching which the trial court gleaned therefrom.

5. Finding No. 9 is premised on Finding No. 8 and is therefore ipso facto erroneous.

6. Claim 23 defines invention over the prior art, and does so in terms of very specifically defined structure which is not found in the prior art.

ARGUMENT

I. The Crucial Findings of Fact Have No Support in the Record.

Findings of Fact Nos. 10, 12 and 14 (App. 64) are the basis of the District Court's conclusion that the plaintiff is not entitled to a patent. Those findings read as follows:

> "10. Claim 23 does not define invention over the Bergh patent disclosure."
>
> "12. Claim 23 does not define invention over the Bergh patent in view of Edling."
>
> "14. Claims 23, 24, 25, 26 and 27 do not define invention over the Bergh patent in view of the prior art."

The only sentence in the opinion (App. 61) which relates to the patentability of the claims in issue says:

> "It seems to the Court that the claims in the pending application do not define structures which are patentably distinct from those of the Bergh patent."

Thus the court below relied upon the Bergh patent, taken either alone or together with other prior art, in support of its conclusion that the claims in suit are unpatentable to the plaintiff. If, therefore, the court below made incorrect findings concerning the material teachings of the Bergh patent, then the lower court's decision must be reversed.

The validity of the lower court's conclusion as to the anticipatory value of Bergh rests upon the correctness of Findings Nos. 6, 7, 8 and 9, relating to the specific teachings of the Bergh patent. Each of those findings is either unsupported by any evidence in the record or is directly contrary to all of the evidence in the record.

Finding of Fact No. 6 (App. 64) reads:

> "The disposition of the lower end of the retort in the Bergh patent at the level of the burning fuel is the equivalent of embedding the lower end of the retort in the fuel."

If this finding means that in Bergh the lower end portion of the retort is or can be embedded in burning fuel, then it is contrary to physical possibility as well as to all of the evidence in the record. The lower end of the retort in the Bergh patent can never be embedded in the burning fuel; moreover, it is questionable whether it could even be said to be "at the level of the burning fuel" since the normal angle of repose which the fuel seeks as it spews from the bottom of the retort disposes the fuel in the combustion zone with its surface slanting downwardly away from the retort. Hence the bottom of Bergh's retort is spaced above all but a very small portion of the burning fuel which is directly adjacent to its lower edge.

Plaintiff, David Dalin, who testified that he was very well acquainted with the Bergh units at Kinne-Kleva and Kvarntorp (App. 58), was asked on cross examination whether the burning coke in Bergh surrounded any portion of the retort. He said that it did not—that it was all *below* it. (App. 59) The point was pressed further:

> "Q. Isn't it to be expected there is to be a little build-up there and that is why he provided those collars 18? A. On the outside?
> "Q. Yes."

The answer was direct and certain:

> "A. No. That is impossible."

But even if Finding of Fact No. 6 is construed as recognizing that only the bottom edge of Bergh's retort is contiguous to the surface of the burning fuel bed, it nevertheless evidences an utter lack of understanding of the fundamentals of applicant's invention and is so seriously in error as in itself to warrant a reversal of the lower court's decision.

Embedding the retort in the burning fuel achieves results which are impossible with the Bergh construction. Hence to talk about the "equivalence" of the relationships between the retort and fuel bed in Bergh and in the present application is like talking about the equivalence of bananas and cabbages.

The applicants began with the premise that by increasing the depth of the distillation zone in the retort they would increase the rate of degassing and thus increase plant capacity. To this end they constructed their apparatus so that a substantial portion of the lower part of the retort is always embedded in the combusting fuel.[1] By so doing a high column of fuel in the retort can be quickly heated to the distillation temperature, thereby enabling such fuel to be degassed much more rapidly than would be possible with the Bergh apparatus.

However, by so embedding a portion of the retort in the combusting fuel the applicants aggravated the sintering problem, for now they not only had to contend with sintering in the combusting fuel bed but also in the fuel undergoing distillation. They held the temperature of the combusting fuel to a value below its sintering point by means of a network of ducts through which heat absorbing fluid circulated, embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft; and to solve the new problem of sintering of the fuel being degassed the applicants arranged some of the coolant carrying coils in juxtaposition to the walls of the retort to thereby abstract excess heat from the fuel within the embedded portion of the retort. (Dalin's Exhibit 1) Obviously Bergh never encountered this problem and having never encountered it he could not have solved it.

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[1] While claim 23 states that at least the lower portion of the retort is embedded in the fuel in the shaft, it would perhaps have been better had the claim called for structure for accomplishing this result as, for instance, "means for transferring fuel from the bottom of the retort to a part of the combustion shaft surrounding a substantial portion of the retort at the bottom thereof to thereby embed said portion of the retort in a bed of fuel; and means for supplying combustion air to the fuel in said bed to maintain combustion therein."

The difference between applicants' invention and the Bergh patent, insofar as it resides in the relationship between the retort and the bed of burning fuel, is graphically illustrated by the fact that with applicants' invention "* * * the combustion can take place in very thick layers up to 4 or 5m." [155 inches to 195 inches] as compared with 1 to 2½ inches in the Bergh apparatus. (Dalin's Exhibit 1, p. 6, App. 58-59)

From this it is obvious that with applicant's invention distillation and combustion will proceed at a rate many times that which is possible with the Bergh apparatus.

Because such a radically improved result is achieved by embedding the retort in combusting fuel, and because the relationship between the retort and the fuel bed in applicant's apparatus was inconceivable to Bergh, the disposition of the retort in Bergh cannot be the "equivalent" of that in the application at bar. Finding of Fact No. 6 is therefore in error, and the error in that finding, moreover, goes to the very heart of this case.

Finding of Fact No. 7 is either meaningless or else contrary to all of the evidence in the record as well as contrary to the disclosure of the Bergh patent itself. That finding says:

> "The fluid conducting pipes in the Bergh combustion shaft above the combustion zone would inherently operate to control temperatures in the shaft."

It may be well that the steaming coils 12 and superheaters 13, by their presence in the upper portion of the furnace shaft, will reduce the heat energy of the flue gases flowing over them, by an amount equal to the heat energy imparted to the fluid circulated through them. But they were not intended to "control" temperatures in the shaft because the intent was merely to obtain steam to be fed into the distillation zone at the outlets 10 in the retorts, and to be fed into the combustion chambers, at the bottoms thereof, through the pipes 8. This intent is clearly expressed in lines 69-78 at p. 1 of the specification. (App. 87)

Any cooling of the flue gases on account of these steaming coils was purely incidental to Bergh's purpose in providing them. Clearly the amount of heat energy abstracted from the hot gases by these coils was determined not by considerations of regulating combustion gas temperatures but by steam requirements for injection into the distillation and combustion zones.

This is further evident from the fact that regulation of the combustion gas temperatures in the neighborhood of the steaming coils would be utterly pointless. To contend otherwise would be diametrically contrary to the unchallenged testimony in the record (App. 28, 31-32), as well as to common sense. It scarcely requires evidence to prove that the temperature in a combustion chamber cannot be regulated by controlling the temperature of the flue gases issuing from it, any more than the temperature of water in a wash basin can be controlled by heating or cooling the fluid in the sewer to which it drains.

Not only are these coils 12 and 13 of the Bergh patent incapable of influencing temperature in the combustion zone, but they would be virtually useless in controlling temperatures in the distillation zone because they are above the hottest part of the distillation region (where sintering is most likely to occur) and are situated in a part of the shaft at which the hot gases have already given up much of their heat energy to the fuel being degassed in the retort.

Finding of Fact No. 7 is thus not only contrary to what is taught by the Bergh patent but is without support in the record.

Finding of Fact No. 8 is crucial because so far as it can be understood it relates to what the lower court recognized as the controlling issue in the case. (Transcript of Trial Proceedings, pp. 112-113) Finding No. 8 says:

> "The air or water conducting pipe embedded in the coke residue in the Bergh furnace would operate, as stated in the patent, to regulate the temperature of the fuel surrounding the pipe."

The difficulty in understanding this finding arises from the fact that it either relates to a minor evidentiary matter on which the parties are in agreement and which in nowise resolves any issue in the case, or else it is crucially in error.

The "air or water conducting pipe embedded in the coke residue" referred to in the finding is undoubtedly the bar 15. There can be no question but that this bar will *influence* the temperature of the coke residue immediately surrounding it, just as a teacupful of water thrown into a blast furnace will influence the temperature in a small area of the furnace and to an immaterial extent. But *influencing* temperature is quite a different thing from *regulating* or *controlling* temperature.

Hence, if the finding merely relates to the very slight influence which the bar 15 will exert upon the temperature of the ash in the small area immediately surrounding the bar, then the finding is not dispositive of any issue in the case, since such insignificant modification of temperature, occurring as a mere incident of some other intended purpose, can in nowise suggest the regulation or control of temperature to preclude sintering which is of the essence of the applicants' invention. *Bernitz Furnace Appliance Co. v. Wilson,* 79 F. (2d) 442 @ 444 (C.C.A.-3, 1935; cert. den. 56 S.Ct. 384, 297 U.S. 703).

However, Finding No. 8 must probably be interpreted as pertaining to the crucial issue which centers around the ambiguous sentence at lines 85-89 of p. 1 of the Bergh specification.[1] That sentence was construed by the Patent Office as relating to the means for cooling the bar 15, referred to in the directly preceding sentence of the Bergh patent.[2]

The ambiguous sentence in question says:

> "The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range, which reacts upon the distilling process."

When applied to the crucial issue in this case Finding No. 8 reflects an interesting psychological process which began with the Patent Office Examiner and culminated in the court below—a process by which Bergh's original meaning was so completely stripped from the sentence in question that when the District Court made Finding No. 8 it was no longer even reading the sentence in the language in which it was written. So firmly have the tribunals below been wedded to the idea that Bergh *must* have intended his bar 15 as a cooling duct that in Finding No. 8 the District Court stated as a fact that Bergh specifically set forth a cooling of the combustion zone which is nowhere expressed in the patent and which the court itself had actually supplied on the basis of hindsight.

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[1] The trial court recognized that this sentence is at the heart of this case. (Transcript of Trial Proceedings, pp. 112-113) The court below was also aware that "While the issue seems to be simple, the determination of it is not so simple." (Id., p. 151)

[2] The sentence preceeding the ambiguous sentence in question reads as follows:

> "Below the row of retorts is placed a bar 15, which preferably is constructed hollow and provided with an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool the bar."

The crux of the issue in this case is the antecedent for "thereby" in the ambiguous sentence. The tribunals below construed it to refer to the cooling means for the bar. The record shows that men skilled in the art do not so construe it. One plausible construction discussed infra is that "thereby" refers to the bar itself.

The member to which the sentence in question refers is said by Bergh to regulate temperature of the coke residue *"in the lower part of the retort."* Bergh does *not* speak of regulating the temperature of the material surrounding the bar 15. The finding says that he does!

This peculiar discrepancy is a significant reflection of the faulty reasoning process by which the District Court arrived at the erroneous conclusion embodied in Finding No. 8.

In that finding the District Court has supplied what it considers to be an implicit intermediate premise in Bergh's explanation. The court began with the assumption that Bergh meant to regulate the temperature of the fuel residue in the lower part of the retort in consequence of the *cooling* influence of the bar 15. Upon this premise the court inferred that Bergh intended to accomplish regulation of temperature in the distillation zone by utilizing the bar 15 to cool the fuel in the *combustion zone*. There is nothing said in the ambiguous sentence in question about cooling the fuel in the *combustion zone*. But the court below, having begun with the assumption that Bergh provided the bar 15 in order to utilize its cooling effect, concluded that this cooling of the combusting fuel must be implied as an intermediate step between the cooling of the bar by air or water and the cooling of "the coke residue in the lower part of the retort."

Because of the assumption from which it started, the District Court was so convinced that this intermediate step was implicit in the sentence in question that it reported, in Finding No. 8, that Bergh actually *said* that he regulates the temperature in the *combustion zone* by means of the bar 15.[1]

The court below found in the Bergh patent a teaching of temperature regulation by means of the cooling influence of the bar 15 only because it interpolated that teaching into the Bergh patent in the first place.

> "The law is not friendly to efforts like this to spell out a later invention in the light of what it has itself disclosed."
>
> *Permutit Co. v. Paige & Jones Chemical Co., Inc.*, 292 Fed. 239 @ 241 (D.C., S.D., N.Y., 1923; modified on another point, 22 F. (2d) 916).

Bergh never said anything about the cooling influence of the bar upon the combustion zone for the reason that he was not interested in that influence. He intended to regulate temperature of fuel in the lower part of the retort in quite another manner.

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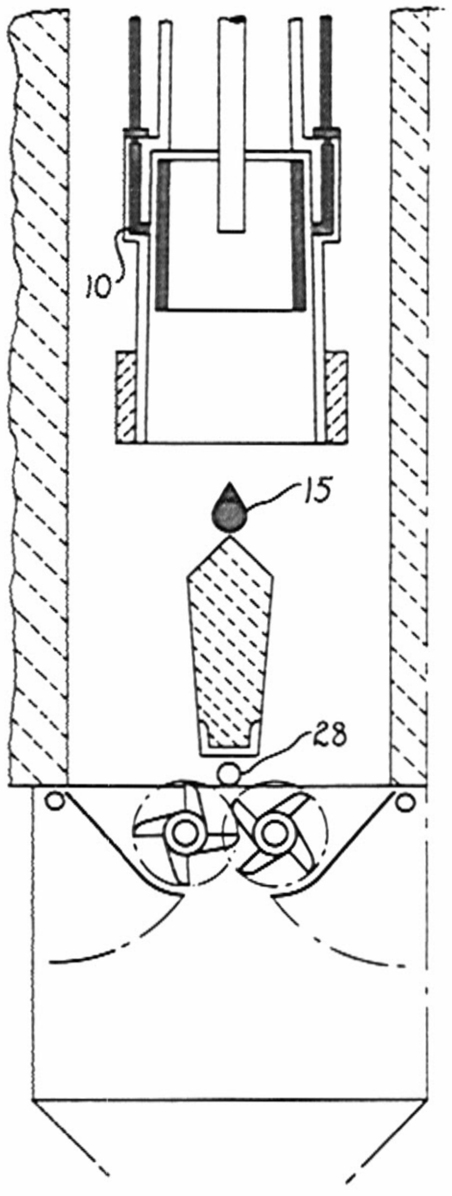
[1] The apparent intention of the District Court in making Finding of Fact No. 8 was to adopt the Patent Office interpretation of the ambiguous sentence in the Bergh patent around which this case seems to revolve. That interpretation is reflected in the cross examination of Mr. Johansson at App. 46-48 and is succinctly stated in the Examiner's Reply to Brief (App. 78): "The patent specification as actually worded (p. 1, lines 81-89) seems to clearly indicate that the function of the *cooling means* for bar 15 is to 'control the temperature of the coke residue in the lower part of the retort'." (Emphasis supplied) It is interesting to note how this interpretation of Bergh's sentence has evolved from the "seems to * * * indicate" of the Examiner to the "as *stated* in the Bergh patent" of Finding No. 8.

BERGH'S BAR 15 INCAPABLE OF PREVENTING SINTERING

BERGH'S PATENT No. 1,618,566



JOHANSSON'S STIPULATED TESTIMONY

"In 1924 the Swedish Marine Department commissioned Sven Wilhelm Bergh, patentee of Patent No. 1,618,566, to install a shale oil plant at Kennekleva, Sweden, * * * . * * * substantially in accordance with the disclosure of the U. S. patent to Bergh * * * . * * *. Each heating chamber had * * * a bar 15 * * * which was cooled by air." *Johansson pp. 3-4*

" * * * to avoid objectionable sintering, very large amounts of excess air were used to cool the fuel bed * * * . No other means were used * * * ." *Johansson p. 5*

"I have carefully read and understand the Bergh patent and its Swedish counterpart No. 76,822. * * * , I can say that the bar 15 of the Bergh patent in nowise controls or regulates the rate of combustion, and was never intended to so operate or function." *Johansson p. 8*

" * * * the bars 15 were a hinderance to the operation of the units and consequently were removed.

"The sole reason for cooling the bar 15 of the Bergh patent was to prevent its destruction due to its location embedded in the hot mass below the combustion zone and entirely shut off from air." * * * to serve any useful purpose in controlling the burning rate and thus preclude sintering, the bar would have to be located within the combustion zone and not below it as is the case in Bergh. Bergh's bar 15 is located well below the combustion zone and such being the case exercised no control on the rate of combustion. Therefore Bergh unsuccessfully relied upon the volume of air introduced into the burning mass from the bottom to control objectionable sintering." *Johansson p. 9*

IRA MILTON JONES

Mr. Johansson, to whose skill in this art even the trial court paid tribute, testified that to him Bergh's silence as to the cooling influence of the bar was significant and clearly understood. (App. 32)

Thus the very language of Finding of Fact No. 8, by its nonconformity with the language of the Bergh patent to which it relates, demonstrates that the finding is seriously in error.

There is another significant discrepancy between the language of Finding No. 8 and that of the sentence in question which further emphasizes the incorrectness of the finding.

Throughout the patent Bergh refers to the member 15 as a *bar*. He does not call it an "air or water conducting pipe", as does Finding No. 8, nor does he refer to it as a tube or duct. His use of the term "bar" emphasizes the fact that he was not in the least interested in any cooling influence which the member might exert upon material immediately surrounding it. He was solely concerned with its function *as a bar,* and its being hollow was purely incidental to its intended function *as a bar*. He passed cooling fluid through it merely to prevent it from being destroyed by the heat of the material around it,[1] and he specifically says that he provides "an inlet pipe 16 and an outlet pipe 17 for air or water, in order to cool *the bar"*—not to cool the fuel residue surrounding it.

Finding No. 8 is not only utterly inconsistent with the language of the Bergh patent, but it is also contrary to all of the pertinent evidence in the record.

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[1] The record shows very clearly and without contradiction that men skilled in the art understood that cooling fluid was passed through the bar 15 for the sole purpose of preventing its destruction. (App. 22, 26, 28, 32, 33, 55)

Prof. Christie testified that the cooling influence of the bar could not reach the bottom of the retort "because the distillation zone is placed so far above the bar it would be impossible to have any influence on distillation." (App. 54) Mr. Johansson testified very positively to the same point. (App. 46-47) The cooling influence of the bar 15 could not have extended to the distillation zone because the bar was located at least 2 inches below the relatively shallow combustion zone and its influence did not even extend upwardly as far as the combustion zone. (App. 28-29, 32, 38)

Moreover, the experts who were working with the Bergh apparatus were not aware of any *intent* to use the bar for its cooling effect, as very forcefully demonstrated by the fact that they never thought to raise it up into the combustion zone where its cooling influence might presumably be advantageous.[1] (App. 48)

It is submitted that the lower court had no room in this case to draw from the evidence inferences contrary to the testimony of the witnesses, not only because their testimony stands uncontradicted but also because of its nature and the qualifications of the witnesses. The high professional caliber of these men, distinguished by excellent educational backgrounds, years of experience in the field in question, and the fact that their work has advanced the art in Sweden to a point where the rest of the world looks to them for guidance — these factors would entitle their testimony to a great deal of weight even if it related only to hypothetical propositions.[1]

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[1] "We agree with the court below that the Thomson patent so lacks that definite description of what is *intended* by such alternative form of the Thomson vane that it does not charge the plaintiff with that knowledge, actual or constructive, which makes it an anticipation."

Atlantic, Gulf & Pacific Co. v. Wood, 288 Fed. 148 @ 155 (C.C.A.-5, 1923; emphasis supplied).

But their unrebutted testimony does not relate to hypothetical problems. Unlike the so-called expert testimony of most patent cases, it is not based on a mere reading knowledge derived from study of a collection of patents. Plaintiff's witnesses, in testifying about Bergh, were not just talking about what they learned from the Bergh patent. They had spent years actually working with the Bergh device itself. It is obvious that a person skilled in the art could not possibly learn anything more from the Bergh patent than he could learn from years of study and operation of the actual Bergh apparatus. It is submitted that when Mr. Johansson testified without contradiction that the bar 15 could not exert a cooling influence on fuel in the combustion zone, much less on that in the retort, the trial court had no room to find otherwise.

But it is not only the plaintiff's highly skilled witnesses who could not find in the Bergh patent this teaching which the District Court attributes to Bergh.

Even Bergh himself did not learn from his patent what Finding No. 8 says is to be found therein! On the contrary, Bergh *strenuously opposed* the actual carrying forward of his supposed teaching when steam generating coils were installed around the bottoms of the Bergh unit retorts. (App. 23-24)

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[1] During final argument the District Court paid an extraordinary tribute to the witnesses (Transcript of Trial Proceedings, p. 120):

> "Frankly, I am very much impressed by the witnesses. In other words, obviously they are men of very high standing and their qualifications are unusual, I would say."

It is not for plaintiff to explain what Bergh did mean by the ambiguous sentence in question. It is sufficient for the purposes of this case to show—as plaintiff has amply done—that men skilled in the art actually could not and did not learn from it the anticipatory teaching which the tribunals below professed to find therein.[1] As a matter of interest, however, these alternative explanations are submitted. Both are necessarily speculative.

1. Mr. Johansson, during cross examination, said that he believed that "each word about regulating refers to * * * the steam inlet 28". (App. 45; see also App. 32) In other words, the sentence refers to the sentence relating to the steam inlets 28 which are beneath the partitions 9, as clearly seen in Figure 1, and are connected by the pipes 8 (shown in Figure 1) with the steaming coils 12. The possibility that this interpretation is correct is strengthened by the fact that the Bergh specification was obviously prepared by someone who was not very familiar with the English language, and the sentence in question may have been transposed out of its order in the course of translation or transcription. Again, it may be that a sentence ahead of it was omitted in some

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[1] " * * * That the description in the prior patent must be tested by the knowledge of persons skilled in the art as it existed at the date of the prior patent is undoubtedly the rule."

Bowers v. San Francisco Bridge Co., 91 Fed. 381 @ 410 (C.C., N.D. Cal., 1898)

" * * * It is not enough to prove that a method or apparatus described in an earlier specification can be made to produce this or that result. * * * A singularly sensible test of the rule of anticipation is given in *British Thomson-Houston Co. v. Metropolitan Vickers Electrical Co.*, 45 R.P.C. 22, by asking the question—'Would a man who was grappling with the problem solved by the patent attacked, and having no knowledge of that patent, if he had had the alleged anticipation in his hand, have said: "That gives me what I wish?" ' "

Skelly Oil Co. v. Universal Oil Products Co., 31 F. (2d) 427 @ 431 (C.C.A.-3, 1929) manner—an oversight which would be all the more likely in view of the disconnected style and extreme brevity of the specification, marked by very little explanatory matter.

2. As the Bergh specification was originally filed the sentence preceding the one in question read:

> "Below the row of retorts is placed a *mechanically operated* bar 15, which suitably is constructed hollow * * * " etc.

The italicized words were later removed by amendment. As explained by Mr. Kohls, the Bergh patent drawing, as originally filed, showed means for rocking the bar 15, and the disclosure of this rocking mechanism was also deleted by amendment. (App. 13-14)[1]

It may be that Bergh contemplated that rocking of the bar 15 would agitate the fuel around it, and such agitation would, of course, be transmitted to the fuel in the bottom of the retort, loosening it and enabling it to fall more rapidly through the lower portion of the retort than would otherwise be the case. In other words, when the bar 15 was being "mechanically operated" the fuel in the lower portion of the retort would be made to traverse the hottest part of the distillation zone more quickly than when the bar was at rest. Thus, by mechanically operating the bar 15 "The temperature of the coke residue in the lower part of the retort can thereby be regulated within a certain range, which reacts upon the distilling process."[1] Grammatically the word "thereby" would more correctly relate to the (mechanically operated) bar which is the subject of the preceding sentence than to the modifying phrase "in order to cool the bar".

---

[1] Mr. Johansson's testimony (App. 45) was given with reference to the patent as it issued, and this may explain his difficulty in construing the crucial ambiguous sentence. The important point is that Mr. Johansson knew what it did *not* mean.

If this theory is correct, then Bergh was merely providing a device (the bar 15) which would utilize the old prior art expedient of regulating the through-put of shale in an effort to control sintering. (App. 29)

> "A document [patent] so obscure in its terminology that two conflicting theories may be deduced therefrom and supported by equally plausible arguments is too indefinite to be utilized as an anticipation."
>
> *Cimiotti Unhairing Co. v. Comstock Unhairing Co.,* 115 Fed. 524, quoted in *Atlantic, Gulf & Pacific Co. v. Wood,* 228 Fed. 148 @ 155.

Finding of Fact No. 9 is likewise contrary to all the evidence. It reads:

> "It would not require invention to provide the Bergh device with additional temperature controlling pipes embedded in the combustion fuel in space [sic] relation."

The finding is of course predicated upon Finding No. 8, and is ipso facto seriously in error because its premise is incorrect.

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[1] It is interesting, and perhaps significant, that this ambiguous sentence does not say *how* regulation of the temperature of the coke residue in the lower portion of the retort reacts upon the distilling process. The conclusion that this regulation and reaction has to do with sintering, or the prevention of sintering, is an entirely gratuitous one, supplied by hindsight. The Bergh patent does not mention sintering. The agitation effected by the bar 15 may well have been intended as a substitute for manual agitation by means of a poker. Cf. App. 34.

Insofar as Finding No. 9 adds anything to Finding No. 8 it is at odds with what is shown in the Bergh patent. Bergh does not show any "temperature controlling pipes embedded in the combustion fuel" or anywhere else. Therefore, the court below had no warrant for its finding that the multiplication of this non-existent element would be lacking in invention. Moreover, there is not the slightest suggestion in the Bergh patent that the cooling influence of the bar 15 was intended to be utilized to control sintering as the finding implies that it was.

It has already been pointed out that at the time of the Bergh patent, and for many years thereafter, those skilled in the prior art knew of only three ways to prevent sintering. If, then, Bergh was telling them to use a fluid cooled duct to prevent sintering, why does the word "sintering" nowhere appear in the patent? Why did he give his instruction in such an ambiguous and indirect manner? Why did he devote nothing more than a brief and indefinite sentence to an idea so important — even revolutionary? Why, if he gave them that suggestion, did not the skilled operators of the Bergh units carry it forward by the logical step of raising the bar 15 into the combustion zone? And why, indeed, did Bergh himself vigorously oppose the plan of carrying his alleged teaching to its presumably logical conclusion when cooling coils were installed around the bottoms of the retorts at Kvarntorp? (App. 23-24)

These questions can have but one answer—Bergh never grasped the important principle involved in the instant application and therefore could not possibly have taught it in his patent. *Trabon Engineering Corporation v. Dirkes,* 136 F. (2d) 24 @ 26 (C.C.A.-6, 1943).

Since the lower court's decision is predicated entirely upon an erroneous conception of what is taught by the Bergh patent, which conception is embodied in the erroneous findings discussed above, that court inevitably arrived at the wrong conclusion.

II. Claim 23 Defines Invention over the Prior Art.

The discussion in this section is limited to claim 23 because it is the only independent claim in the case, the others being dependent thereon, and plaintiff's case might be said to stand or fall with that claim. While the court below made no specific findings with respect to the form of claim 23 the question was discussed at some length upon oral argument (Transcript of Trial Proceedings, p. 126 et seq.), and was raised by the cross examination of Mr. Kohls. (App. 16-17)

Counsel for the Patent Office took the position during closing argument that claim 23 depended upon a statement of function to distinguish from Bergh, and this argument, although not involved in the decision of the lower court, is deserving of some attention. Defendant's argument is predicated upon *In re Dalton et al,* 188 F. (2d) 170 (C.C.P.A., 1951), and particularly the language at p. 173:

> "All of the claims before us are drawn to define structure and in order to be patentable they must depend upon the novel structure set out. Properties, functions, uses, and results that may appear from the defined structure are not definitions of it and may not be solely relied upon to make a claim containing them patentable unless there is a positive setting out of the structure itself in the claims which, of course, must be responsible for properties, functions, uses, and results thereof."

Plaintiff has no quarrel with the proposition of law embodied in the foregoing quotation, and the question, therefore, is whether claim 23 includes "a positive setting out of the structure itself" by which the invention of this application is distinguished from the reference devices, or whether it depends upon statements of "properties, functions, uses, and results" for its novelty. This question is best answered by an analysis of the claim itself.

The claim calls for "an upright combustion shaft in which fuel is adapted to be burned to provide the heat necessary for distillation." There can be no question that this element of the claim very definitely defines structure, Nor can there be any doubt about the next element: "an upright retort in said combustion shaft at least the lower portion of which is embedded in the fuel in the shaft." There follows a statement of function concerning the retort, which statement is merely explanatory of the purpose of the retort, and except for purposes of clarity it could probably have been omitted from the claim: "said retort being adapted to contain material to be distilled by the heat of combustion in the shaft."

Controversy centers upon the next element of the claim, which embodies definitions of two very specific and distinctive types of structure. This part of the claim begins with an introductory statement which of itself is not intended to distinguish from the art but is included in the claim merely for the sake of clarity: "means for controlling the temperatures in the shaft and the retort to preclude attainment of temperatures therein at which sintering of the fuel and the distillant takes place." This clause might as well have been placed at the end of the claim in which position its purely explanatory nature would perhaps be more evident.

The heart of the claim is found in the lines which follow this explanatory clause and which define the "means for controlling the temperatures in the shaft and the retort" referred to therein. They begin with a general statement of the nature of the structure which distinguishes the invention: "said means comprising a network of ducts through which a heat absorbing fluid circulates." This is followed by a more specific definition of the locations of the ducts comprising this network: (1) "certain of said ducts being embedded in the fuel[1] in the shaft and dispersed at intervals transversely of the shaft so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft". (2) "and the remaining ducts being arranged in juxtaposition to the walls of said embedded portion of the retort". There can be little question that this last quoted language defines a specific structure comprising an arrangement of ducts and further defines the positional relationship of these ducts both with respect to one another and with respect to the walls of the retort and the shaft.

It is difficult to determine from the argument of counsel for the Patent Office as reported in the transcript whether he took the position that (1) Bergh taught (in the ambiguous sentence discussed at length above) that the bar 15 could be used to control sintering to some extent and that it would not amount to invention to multiply the number of such bars to afford a greater measure of such control; or (2) that regardless of the intended function of the bar 15 in Bergh, merely multiplying this known bar, and attributing to the product a new function, is not enough to impart patentable novelty to it.

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[1] It might perhaps have been better to avoid defining the ducts in relation to the fuel, since the fuel then becomes (by implication) a part of the claimed combination. The ducts might have been defined as "dispersed through the portion of the shaft in which combustion of fuel is adapted to occur", or "spaced at intervals across the horizontal cross section of the shaft at least in the neighborhood of the bottom of the retort" (the latter avoiding all dependence upon "fuel" as an element of the definition). It is submitted, however, that the claim is reasonably clear and understandable in the form in which it is presented. The form of the claim can be improved in the course of subsequent Patent Office prosecution if the subject matter thereof is held to be patentable to the applicants.

(1) If counsel for the Patent Office premises his position upon the ground that the ambiguous sentence in Bergh teaches the use of cooling means embedded in the fuel to control sintering, then, as has already been shown at length, the entire argument falls, for men highly skilled in the art were not able to glean that teaching from the Bergh patent, the Bergh apparatus built according to the patent, or Sven Vilhelm Bergh himself.

(2) If the Bergh patent does not teach or suggest that the bar 15 can control sintering by its *cooling* effect—and the evidence is conclusive that Bergh does not even suggest this to men skilled in the art—then a network of ducts positioned as defined in the claim to effect such control constitutes an entirely new device. It is no more a mere multiplication of the bar 15 than a fishnet is the multiplication of a piece of string. The improved result is not one of degree, but of kind; and there is thus no room to argue that applicants must depend upon a statement of the function of the network to impart patentable novelty to the claim.

> "* * * Invention cannot be defeated merely by showing that, in one form or another, each element was known or used before. [Citing cases]
>
> "The question is: Did anyone before think of combining them in this manner in order to achieve the particular unitary result,—a new function? *If not, there is invention.*"

Pointer v. Six Wheel Corporation, 177 F. (2d) 153 @ 160 (C.A.-9, 1949; emphasis in original; cert. den. 339 U.S. 911, 70 S. Ct. 570).

CONCLUSION

Since the District Court predicated its decision upon the Bergh patent, the correctness of that decision depends upon whether or not the District Court correctly interpreted the teaching of the Bergh patent.

The language of the Bergh patent, the operation of the plants built in accordance with the disclosure of that patent, the unrebutted testimony of men possessing unusually high skill in the art, the conduct of Bergh himself—all demonstrate that the District Court found in the Bergh patent a teaching which it had itself read into that patent in the light of the applicants' disclosure.

Since the District Court predicated its decision upon a grossly erroneous premise, its judgment must be reversed.

This Court should therefore direct the court below to enter judgment for the plaintiff requiring the Commissioner of Patents to issue Letters Patent in accordance with the prayer of the Complaint.

Respectfully submitted,
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September 17, 1952

BRIEF FOR THE COMMISSIONER OF PATENTS

In the United States Court of Appeals for the District of Columbia Circuit

Appeal No. 11,479

David Dalin, *Appellant*

ROBERT C. WATSON v.

John A. Marzall, Commissioner of Patents,
Appellee

Appeal from the Judgment of the United States District Court for the District of Columbia

E. L. Reynolds,
Solicitor, United States
Patent Office,
Attorney for Appellee.

S. W. Cochran,
Of Counsel.

Appeal No. 11,479

STATEMENT OF QUESTIONS PRESENTED

The appellee disagrees with the Statement of Question Presented which appears in the Brief for Appellant. In the opinion of the appellee the questions are whether the claims in the appellant's application involve invention over (1) the Bergh patent No. 1,618,566 and (2) over the Bergh patent in view of the Edling patent No. 2,504,508.

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In the United States Court of Appeals for the District of Columbia Circuit

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Appeal No. 11,479

DAVID DALIN, *Appellant*

v.

JOHN A. MARZALL, Commissioner of Patents,
Appellee

Appeal from the Judgment of the United States District Court for the District of Columbia

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BRIEF FOR THE COMMISSIONER OF PATENTS

INTRODUCTION

This in an appeal from the judgment of the United States District Court for the District of Columbia (App. 62) dismissing the complaint (App. 1 to 4) in an action under R. S. 4915 (U.S.C., Title 35, Section 63) in which the appellant, David Dalin, sought to have the Court authorize the issuance of a patent on application Serial No. 648,796, of which he is assignee. The refusal of the patent by the Patent Office and the District

Court was based upon lack of invention over the prior art.

APPELLANT'S APPLICATION

The application involved in this appeal relates to an apparatus for distilling valuable vapors and gases from oil shale. The essential features of the device are thought to be sufficiently and accurately described in the appellant's brief on page 10.

THE BERGH PATENT

The Bergh patent No. 1,618,566 (App. 85) discloses an apparatus for the destructive distillation of oil bearing shale and the like in which the untreated material is fed to the interior of a retort 3 wherein distillation takes place due to heat applied to the walls of the retort, the gas produced being carried off by pipes 6. The coke residue passes from the bottom of the retort to form a combustion bed to supply heat within the shaft 1. Disposed within the space between the shaft wall and the retort are steam producer pipes 12 and super heater pipes 13 which absorb a portion of the heat. Below the retort is a water cooled pipe 15, the function of which is in dispute.

THE EDLING PATENT

The patent to Edling No. 2,504,508 (App. 113) is directed to an apparatus and process of degassing and burning fuel, such as oleaginous shale, in such a manner as to prevent sintering (melting) of the fuel. The Edling method, reduced to its essentials, comprises disposing cooling pipes in the combustion zone of the furnace, the heat absorbing medium in the pipes being supplied in such quantity as to keep the combustion zone below the sintering temperature. In the particular apparatus shown by Edling, the walls of the combustion shaft 5 are formed of cooling pipes 16, untreated shale being supplied at 1 and the gas being recovered at 23.

THE PARR ET AL PATENT

The patent to Parr et al. No. 1,827,483 (App. 97) was cited to show the conventionality of heating fuel solely by conduction through retort walls, as called for by claims 24 and 25. Since the appellant no longer urges that the latter claims offer anything patentable over basic claim 23, detailed consideration of the Para et al. patent is unneccessary.

SUMMARY OF ARGUMENT

1. The appellant does not urge that claims 24, 25, 26 and 27 are patentable over claim 23, and the latter claim only need be considered.

2. Disposing the fuel about the lower end of the retort is not a critical feature of the appellant's disclosure and, therefore, is not inventive.

3. Pipes 12 and 13 in Bergh's device inherently lower, and thereby control the temperatures in the Bergh shaft 1.

4. Bergh's embedded pipe or bar 15 cools the coke residue which surrounds it.

5. Whether the bar 15 in Bergh operates to prevent sintering of the fuel is not in issue since, to be patentable, claim 23 must define over Bergh by *structural* limitations.

6. Although such a finding is not necessary to support the District Court decision, the evidence indicates that Bergh disclosed member 15 as functioning to cool the combustion zone.

7. The duplication of the Bergh pipes 15 to provide a plurality thereof would not be inventive.

8. The Edling patent teaching, when applied to Bergh, cures the principal omission which the appellant finds in the latter disclosure.

9. Claim 23 presents nothing patentable over Bergh in view of Edling and the appellant has presented no argument contesting this conclusion.

ARGUMENT

The claims in issue in this appeal appear in the appellant's application as claims 23, 24, 25, 26, and 27. The latter four claims are phrased to include all of the features of claim 23, i.e., are dependent thereon. However, both at the trial (App. 60) and in the appellant's brief (Brief, page 11, note 1) counsel for the appellant agreed that claims 24 to 27 did not differ patentably from claim 23. Accordingly, by agreement of both parties, the propriety of the Patent Office and District Court decisions can be determined by limiting consideration to claim 23 alone. Claim 23 is reproduced in the joint appendix on page 73 as part of the Examiner's Statement before the Board of Appeals and on the drawing facing page 10 of the appellant's brief.

As one of the two grounds for refusing to grant claim 23, the District Court held (Finding of Fact No. 10, App. 64) the claim non-inventive over the Bergh patent disclosure. The appellant takes issue with this holding by attacking in turn the Court's Findings of Fact Nos. 6, 7, 8 and 9, which relate to the particular features of claim 23 said by the appellant not to be disclosed in Bergh and to be inventive thereover. Each of these findings is believed to accord with the evidence as set out below.

Embedding the End of the Retort in Fuel Does Not Define Invention Over Bergh

While it is not believed that the evidence conclusively establishes that *no* fuel can build up around the lower end of the Bergh retort, this limitation in claim 23 is believed to be immaterial to the question of patentability for several reasons. First, as a structural feature, it is apparently quite independent of the primary feature of the appellant's disclosure, i.e., the control of combustion temperatures.

Secondly, the appellant's present contention that unexpected results are thereby achieved, such as an increased output because of a deeper combustion zone is not supported by the evidence (the trial proved that the increased output was due to control of the combustion temperature). The drawing Figure 46, on page 11 of plaintiff's exhibit 1, shows that the use of cooling coils produced the deeper combustion zone mentioned *entirely below the lower end of the retort* and shows the alleged "unexpected" result to be entirely independent of the embedding of the retort. Moreover, the claim does not specify the *amount* of the embedding while the appellant admits that a "substantial" portion of the retort must be embedded to obtain the effect noted (See note 1, page 18 of the Appellant's Brief).

Study of the specification not only fails to show any mention of embedding the retort as a critical feature, ~~It~~ it is explicitly stated that the heat for distillation need not be supplied by the combustion of coke residue in the shaft, but may be generated in a separate combustion chamber and supplied to the retort by pipes. The appellant cannot base patentability on a feature which his own application says is immaterial.

Bergh's Pipes 12 and 13 Act to Control the Temperature in the Shaft

Part of the structure called for by claim 23 is a "network of ducts through which a heat absorbing fluid circulates" for controlling temperatures in the shaft and the retort. The defendant's position, which was adopted by the District Court, was that pipes 12, 13 and 15 in Bergh constituted a network for the described purpose.

Appellant now contends (Appellant's brief, last paragraph, page 7 to end of page 8) that ducts 12 and 13 were provided for the purpose of generating steam, not control of shaft temperatures, and that control in the shaft would be pointless since there would be no effect on the distillation.

However, the appellant's statement (Brief, last paragraph, page 7) that the ducts would absorb heat from the flue gases constitutes an admission that there would be "control" to the extent of lowering temperatures in the shaft, and this is the *same type of "control"* contemplated for the appellant's pipes 12a and 12b.

Moreover, it is not believed that the cooling effect of Bergh's ducts would be "pointless" since any degree of cooling would result in less heat being transmitted to the distillation zone through the retort walls. This effect is mentioned in Plaintiff's Exhibit 1 on page 4, second paragraph, which states in referring to the original Bergh apparatus (Fig. 4a) "The temperature in the retort shaft has a tendency to rise above that desired for best pyrolysis results. For this reason cooling elements have been installed on each side of the retorts not far above the fuel bed.—" The contention that Bergh's pipes are disposed too high in the shaft to have a cooling effect does not accord with the facts since pipes 12 end more than half way down the shaft and pipes 13 extend almost to the bottom of the retort.

The evidence manifestly supports Finding of Fact No. 7.

Bergh's Member 15 Cools the Coke Residue in Which It Is Embedded

As a matter of structural relationship, claim 23 requires that certain of the ducts in the temperature controlling network be embedded in the fuel in the shaft. Thus, all that is required of Bergh's member 15 is that it be embedded in fuel and that it exert a cooling influence thereon. Bergh explicitly states that member 15 is embedded in and regulates the "temperature of the coke residue" (App. 87, lines 81 to 89). The appellant admits this to be so in his brief: "There can be no question but that this bar will *influence* the temperature of the coke residue immediately surrounding it——".

The appellant thus confirms the propriety of Finding of Fact No. 8. His long and vigorous argument

(Brief, pages 21 to 30), ostensibly directed to an attack on the finding, actually deals with other matters, such as whether bar 15 is so placed relative to the combustion zone in Bergh as to *prevent sintering.* Finding No. 8 makes no mention of the function of "preventing sintering" because a consideration of this effect is not necessary to determining the patentability of claim 23. The latter, being directed to an apparatus, must recite *apparatus* features which distinguish from the prior art. The prevention of sintering is no more the *desired effect* which, of course, has no bearing on the patentability of the apparatus. "A characteristic essential to novelty may not be distinguished from the old art solely by its tendency to remedy the problems in the art met by the patent", *General Electric Co.* v. *Wabash Appliance Corp. et al.,* 304 U. S. 364.

Although, as stated above, it is not believed necessary to establish that the Bergh patent taught control of temperatures in the combustion zone, there is substantial evidence, it is submitted, showing that Bergh is sufficient in this respect. Mr. Johannson's opinion as expressed on direct examination (App. 26) was based on observation of an actual so-called "Bergh" furnace in Sweden, which, apparently did not conform to the U. S. Patent disclosure. On cross-examination (App. 45, lines 18 to 28) Johannson admitted that Bergh, in his patent, intended that bar 15 should regulate the temperature in the combustion zone, but he did not believe it would so operate. Moreover, claim 3 in the Bergh patent specifies bar 15 as "means for regulating the temperature of the coke-residue" (App. 88, lines 52 and 53). Mr. Johannson further stated (App.

48, lines 8 to 13) that the only change required in the Bergh structure to impart to bar 15 the regulating function described by Bergh would be to place the bar somewhat higher in the combustion zone, an alteration which certainly would offer no difficulty to the ordinary worker. Where the cure for an alleged inoperativeness of a patent is obvious, the alleged defect cannot be held to affect the validity of the patent as a reference; *In re Japikse,* 181 F. 2d 1019, 37 CCPA 1026.

Even if the most favorable view be taken of all of the appellant's contentions with respect to conduit 15, i.e., the patent language does not reflect Bergh's actual intent, etc., the description of the conduit must be considered from the aspect of what it would teach a skilled worker in the art. So considered, it is believed obvious that the Bergh patent constitutes a suggestion that pipes embedded in the combustion fuel could be used for temperature regulation.

Duplication of Pipes 15 in Bergh Would Not Require Invention

Claim 23 calls for a plurality of spaced, embedded pipes which requires, of course, no more than a noninventive duplication of the Bergh pipes 15. It is not understood that the appellant contests this particular point particularly in view of Mr. Johannson's admission (App. 48, lines 14 to 18) of the obviousness of such an expedient.

Claim 23 Is Unpatentable Over Bergh in View of Edling

Although Findings of Fact 11 and 12 dealt specifically with the inventiveness of claim 23 over the combined teachings of Bergh and Edling, the appellant makes no argument directed explicitly against these findings, apparently in the belief that his attempt to discredit Bergh alone would be sufficient.

However, the only substantial defect in Bergh as a reference, according to the appellant, is his failure to definitely teach the use of a series of pipes embedded in the combustion zone to prevent sintering and *it is precisely this concept which is furnished by Edling* (see claim 4 of Edling, App. 117). Applying the Edling principle to the Bergh structure could have but one result, the disposition of a series of spaced cooling pipes in the Bergh combustion zone. Even in the absence of direct evidence, the obviousness of combining the two reference teachings is thought to be evident, but the point is established beyond question by testimony by Mr. Johannson when, in answer to inquiry by the Court as to what changes he would make in Bergh in the light of Edling's claim 4, he stated:

> "I would put in these tubes, embedded directly in the hot mass to get a cooling effect on the whole hot mass."

Thus, the only substantial defect which the appellant can find in Bergh is cured by an obvious application of the Edling teaching. Even if Findings 6, 7, 8 and 9 were found unsupported by the evidence, Findings 11 and 12 stand unchallenged either by the appellant or by the evidence. The District Court was manifestly correct in finding claim 23 non-inventive over Bergh in view of Edling.

CONCLUSION

It is respectfully submitted that not only has the appellant failed to show obvious error in the District Court decision, each and every one of the Court's findings is supported by ample and adequate evidence. The decision of the District Court should, therefore, be affirmed.

Respectfully submitted,

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REBUTTAL BRIEF FOR APPELLANT

In The

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA

DAVID DALIN, *Plaintiff-Appellant,* *v.* ROBERT C. WATSON JOHN A. MARZALL, Commissioner of Patents, *Defendant-Appellee.*	**Appeal No. 11,479**

Appeal from Judgment of the
District Court for the District of Columbia

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DAVID DALIN,
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v.
JOHN A. MARZALL,
Commissioner of Patents,
Defendant-Appellee.

Appeal No. 11,479

REBUTTAL BRIEF FOR APPELLANT

DEFENDANT IS IN ERROR IN HIS STATEMENT CONCERNING CLAIMS 24-27

Defendant, the Commissioner of Patents, states at p. 4 of his brief that it is "agreed that claims 24 to 27 did not differ patentably from claim 23." This statement is inaccurate, since the patentability of claims 24 to 27 over claim 23 upon which they depend was not involved in the stipulation. The exact language of the stipulation was: "If claim 23 falls, the rest of them fall, too." (App. 60)

It is true, however, that this Court can arrive at its decision by considering claim 23 alone.

DEFENDANT'S COUNTER-STATEMENT OF THE QUESTIONS PRESENTED

Defendant has taken issue with plaintiff's statement of the question presented. Defendant says that the question is whether the claims of plaintiff's application involve invention over the prior art patents. This is too general. Much more fundamental and specific is the question of what the prior art patents teach. If the prior art patents—and particularly the Bergh patent—teach what the defendant professes to find in them, then it may be that the claims of the plaintiff's application do not define invention over those patents. But if the Bergh patent teaches what was found therein by the skilled and experienced witnesses who worked with the device of that patent, then the Bergh patent taken either alone or with other prior art does not anticipate the claims in issue.

This counter-statement of the issue on this appeal is but one phase of a begging of the question which runs through defendant's brief. Defendant has founded his arguments upon the assumption that the Bergh patent teaches something that men highly skilled in the art were never able to find therein. Stated in another way, defendant is asking this Court to ignore all of the evidence in the record and affirm findings of the court below which are contrary to that evidence and which find their support only in an interpretation which has been given to the ambiguous language of the Bergh patent by laymen untutored in the art to which the patent relates.

When defendant has approached the real question in this case it has been by such significant evasions of the issue as "it is *believed obvious* that the Bergh patent constitutes a suggestion that pipes embedded in the combustion fuel could be used for temperature regulation". (Defendant's brief, p. 9, emphasis supplied)

Thus the fundamental question in this case remains as stated in plaintiff's brief and may be rephrased as follows: Was the court below justified in adopting an interpretation of the Bergh patent which the Commissioner, having the benefit of applicants' teaching, believed "obvious" but which interpretation is directly contrary to all of the uncontradicted and unrefuted evidence in the record, including the testimony of men highly skilled in the art?

DEFENDANT'S ARGUMENT CONCERNING EMBEDDING THE LOWER PORTION OF THE RETORT

Defendant contends that the limitation in claim 23 that at least the lower portion of the retort is embedded in the fuel in the shaft is "immaterial to the question of patentability." (Brief, p. 5)[1]

Defendant argues first that this "as a structural feature * * * is apparently quite independent of the primary feature of the appellant's disclosure, i.e., the control of combustion temperatures." (Brief, p. 5) This is not correct. As explained at length at p. 17-18 of plaintiff's main brief this embedding of the retort in the combusting fuel bed is utterly dependent upon the network of cooling ducts, for without that network such an embedding of the retort would result in destruction of the retort within a very short time, to say nothing of the hopeless sintering problem which would be created.

---

[1] Defendant says that "it is not believed that the evidence conclusively establishes that *no* fuel can build up around the lower end of the Bergh retort." But defendant does not cite a word of testimony to the effect that such a build-up occurs, and the only evidence in the record concerning the point very specifically negatives such a build-up.

Defendant undoubtedly fails to understand the physics of the apparatus because of a confusion with what would occur if a liquid were poured into the top of the retort. But shale is not a liquid and does not behave like a liquid. The type of thinking which doubts the testimony of well qualified experts on this relatively minor point pervades defendant's entire case.

Defendant then argues that the deepening of the combustion zone resulting from this embedding of the retort (with consequent tremendous increase in plant capacity) is not supported by the evidence, but that "the trial proved that the increased output was due to control of the combustion temperature." (Brief, p. 5) The contradiction which defendant seeks to establish resolves itself, instead, into a logical cause-and-effect relationship. A certain amount of time is obviously required for both the degassing and the combustion processes, even under optimum conditions, and plant capacity cannot be increased, therefore, unless more shale is being processed at any given instant—that is, unless the combustion and distillation zones are deepened. And, as Mr. Johansson testified, the increased output resulted from control of the combustion temperature *because* such control enabled the deepening of the combustion zone. (App. 35)

Defendant also argues that the drawing, Figure 4b[1] on p. 11 of Plaintiff's Exhibit 1, "shows that the use of cooling coils produced the deeper combustion zone mentioned *entirely below the lower end of the retort.*" (Emphasis in defendant's brief)

This is undoubtedly true in the case shown in the exhibit—but Figure 4b of the exhibit is *not* a drawing of the structure defined by the claim of the application. Figure 4b shows a modified Bergh unit embodying some of the principles of the present invention, but, as indicated in the text of the exhibit (p. 10, 12) further improvements continued to be made in the basic concept shown therein.

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[1] Defendant inadvertently refers to this as "Figure 46". (Brief, p. 5)

Defendant also insists that claim 23 is deficient because it does not specify the *amount* of the embedding. It is submitted that the phrase in the claim "at least the lower portion of which [retort] is embedded in the fuel in the shaft" makes it clear that something more than the lower edge of the retort is so embedded. The word "embedded" in itself implies that a substantial portion of the retort is surrounded by combusting fuel.

Finally, defendant says that the specification describes an alternate means of heating a substantial portion of the fuel in the retort, namely by generating hot gas in a separate combustion chamber and supplying it to the retort by pipes. From this defendant draws the conclusion that the embedding of the retort is immaterial. This is a non-sequitur. Plaintiff is claiming one species of the invention. There are other—less satisfactory—means for heating fuel in the retort in a distillation zone of substantial depth, one of these means being shown in Figure 4b of Plaintiff's Exhibit 1, and another being the alternative described in the specification and to which defendant refers. Simply because there are other conceivable means for accomplishing this end does not make the one claimed by plaintiff any the less inventive, nor does plaintiff know of any rule which would require him to claim these less satisfactory means of attaining his objective.

DEFENDANT PERSISTS IN THE ERROR THAT BERGH'S PIPES 12 AND 13 "CONTROL" TEMPERATURE IN THE SHAFT

Throughout his brief, the defendant has fallen into the error of confusing *"influence"* with *"control"*. It must be clearly understood that elimination of sintering can be achieved only by *control* of temperatures. Merely to *influence* temperature in the distillation or combustion zone accomplishes nothing.

Because plaintiff has made the irrelevant acknowledgment that Bergh's steam generating ducts 12 and 13 *influence* temperature in the *upper* part of the shaft, defendant attributes to plaintiff "an admission that there would be 'control' to the extent of lowering temperatures in the shaft, and this is the *same type of 'control'* contemplated for the appellant's pipes 12a and 12b." (Brief, p. 6, emphasis in original) This statement and the paragraph which follows it reflects a significant lack of understanding of the nature of the apparatus employed in destructive distillation of oil shales. The distillation zone in such apparatus is near the bottom of the retort. The hottest part of the distillation zone in the Bergh apparatus will obviously be directly above the combustion zone (App. 59), yet the Bergh patent drawings show the tubes 12 only in about the uppermost one-half of the combustion shaft, and the superheaters 13 do not extend down to the hottest part of the shaft; even if they did they would be utterly inadequate to *control* the temperature there, as pointed out in appellant's main brief. (p. 19-20)

More important, however, is the fact that Bergh's steam generating tubes 12 and 13 can have no effect whatsoever upon the *fuel* in the combustion zone. As explained in plaintiff's main brief, these tubes exercise their cooling influence only upon the combustion gases which have left the bed of combusting fuel, and can have no more influence upon temperature in the combustion zone than a green lawn exerts upon the pressure of water at the nozzle of a garden hose.

Thus to say that the pipes 12 and 13 "affect" temperatures in the shaft in any respect, whether by influence or "control", is utterly irrelevant, since there is no teaching that these steam generating tubes (multiplied many times and "dispersed at intervals transversely of the shaft") should be lowered into the combusting fuel itself, where they would have to be located, to prevent sintering thereof. Indeed, as pointed out in plaintiff's main brief (p. 31), any such suggestion is expressly negatived.

Finally, it is not known what is meant by the statement that the lowering of the temperature in the combustion shaft by the steaming coils 12 and 13 "is the same type of 'control' contemplated for the appellant's pipes 12a and 12b." There is no such thing as a "type" of control. Either sintering is controlled or it is not, but *influencing* temperature somewhere in the combustion shaft is not the same thing as *controlling* it in the combusting fuel to avoid sintering thereof.

Defendant also argues that the pamphlet plaintiff's Exhibit 1, on p. 4, second paragraph, shows that coolant ducts were "installed on each side of the retorts not far above the fuel bed" in the original Bergh ovens and that the effect of these ducts was to control temperature in the distillation zone to maintain it below the critical sintering value. This argument again reflects the errors into which one with no knowledge of the art may fall when he attempts to make his own interpretation of writings addressed to men skilled in the art.

In the first place, it is to be noted that the first two sentences of the paragraph in question of plaintiff's Exhibit 1 do not refer to sintering. They relate to "best pyrolysis results." Once again defendant has drawn a purely gratuitous relationship. "Best pyrolysis results" does not necessarily have anything to do with the degassing of the shale or with sintering, but relates to the quality, as well as quantity, of the distillate gases. Exposure of these gases to excessive heat will cause chemical changes in them which decrease their value.

Secondly, sintering was not much of a problem in the *retort*[1] shaft, to which the sentences in question relate, and consequently the teaching that cooling elements may be used *above* the fuel bed, even if it did suggest a means of controlling sintering in the *distillation* zone, would still teach nothing about how to solve the really vital problem of sintering in the *combustion* zone.

DEFENDANT'S ARGUMENT CONCERNING BERGH'S BAR 15

The section of defendant's brief which deals with Finding of Fact No. 8 ends with the following self-contradictory statements which expose the very essence of defendant's error: "The description of the conduit must be considered from the aspect of what it would teach a skilled worker in the art. So considered, *it is believed obvious* that the Bergh patent constitutes a suggestion that pipes embedded in the combustion fuel could be used for temperature regulation." (Defendant's brief, p. 9, emphasis supplied) In one breath defendant says that the specification of Bergh's patent "must be considered from the aspect of what it would teach a skilled worker in the art." In the next breath defendant implies that all of the testimony of skilled workers which deals with this very point (and which is uncontradicted and unrebutted) must be discarded in favor of a conclusion that is totally unsupported in the record and is derived from the alleged obviousness of the Commissioner's interpretation of a sentence of the specification that is at best ambiguous.

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[1] At p. 2 of Dalin's Exhibit 1 it is pointed out that dry distillation takes place at 400° to 500° C., the higher value giving much faster results. The critical sintering temperature for shale is given as 950° C., which is substantially above the optimum degassing temperature but substantially below the optimum combustion temperature. In the applicants' structure, however, where a distillation zone of substantial depth is contiguous to combusting fuel because of the embedding of the lower portion of the retort, some provision must be made to prevent transfer of excess heat to the distillation zone, both for "best pyrolysis results" and to prevent sintering. This takes the form of the ducts "arranged in juxtaposition to said embedded portion of the retort."

In the paragraph beginning at the bottom of p. 7 defendant argues that "the prevention of sintering is no more [than] the desired effect which, of course, has no bearing on the patentability of the apparatus." Defendant ignores completely the fact that claim 23 brings out a very substantial distinction between the structure of the instant application and that of Bergh in its specific recitation of "a network of ducts" certain of which are "embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft" and the remainder of which are "arranged in juxtaposition to the walls of said embedded portion of the retort".

In a very limited sense it may be said that this network of ducts constitutes a multiplication of the bar 15 in Bergh (when that bar is cooled with water) moved to a different location and performing a new and unexpected function. It would be as logical to say that a fish net is a mere multiplication of a piece of string.[1]

Defendant has also attacked plaintiff's interpretation of the Bergh patent by misconstruing Mr. Johansson's testimony. Defendant begins by saying (p. 8): "Mr. Johansson's opinion as expressed on direct examination (App. 26) was based on observation of an actual so-called 'Bergh' furnace in Sweden, which, apparently did not conform to the U. S. patent disclosure." This is contrary to Mr. Johansson's very positive testimony a few lines farther down on the same page, which was never contradicted or rebutted:

> "Q. Please refer to the showing, more particularly in Figure 1 of the Bergh U. S. patent 1,618,566, and what have you to say as to whether the original Bergh furnace followed the construction shown in this Bergh patent, both as to construction and as to general proportions? A. Yes.
>
> "Q. That would follow? A. That is right."

Defendant also attributes to Mr. Johansson an admission that Bergh "intended that bar 15 should regulate the temperature in the combustion zone." This is not accurate. A careful reading of Mr. Johansson's testimony at App. 45 will demonstrate that the witness conceded that the ambiguous sentence of the Bergh patent *grammatically* related to the bar 15, but he also made it clear that to him, as a man skilled in the art, it related to something else (steam inlet 28) and that in the light of his knowledge he would not have interpreted the sentence to refer to bar 15.[2]

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[1] Defendant's argument concerning this "mere noninventive duplication" is further discussed at p. 11 infra.

[2] Mr. Johansson's confusion undoubtedly arose from the fact that he was testifying from the Bergh patent as issued, in which all reference to the mechanical linkage between the bar 15 and the grates had been deleted, together with the statement that the bar is movable.

Defendant also refers to claim 3 of the Bergh patent (brief, p. 8) and makes the entirely gratuitous assertion that the "means for regulating the temperature of said coke-residue" recited therein relates to the bar 15. The claim does not specify what this "means" consists of, or how it is to effect such regulation, or for what purpose such regulation is effected, but merely recites "means", broadly, followed by the functional statement. The element of the claim must therefore, be interpreted in the light of the knowledge in the art at the time, and so understood it probably refers to means for regulating temperature of the coke residue by the then well-known expedient of *increasing the through-put of shale.* This theory is further substantiated by the fact that claim 2 of Bergh, as originally presented (claim 4 of Paper No. 3), called for "means for mechanically discharging the ashes from said combustion chambers *and at the same time moving the fuel in the retort and the combustion chambers.*" The italicized clause was deleted by subsequent amendment, but it clearly referred to the movable bar 15, together with its mechanical linkage to the grate, further demonstrating that Bergh intended to utilize the bar 15 for its effect as an agitator, for varying the through-put of shale, and cooled it only to prevent its destruction.

DEFENDANT'S ARGUMENT THAT DUPLICATION OF BERGH'S BAR 15 WOULD NOT REQUIRE INVENTION

Defendant brushes away the specific language of claim 23 with the statement that it calls for "a plurality of spaced, embedded pipes which requires, of course, no more than a non-inventive duplication of the Bergh pipes[1]

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[1] It will be noted that defendant insists upon referring to the bar 15 of Bergh as a "pipe". There is no warrant in the patent for this terminology. (Plaintiff's brief, p. 25)

15." Even assuming that plaintiff's "network of ducts" is a "duplication" of Bergh's bar 15 (and it has already been demonstrated that it is not) that fact in itself would not necessarily militate against the inventiveness of plaintiff's claimed structure. Plaintiff, by this so-called duplication, achieved a new and unexpected result for which the art had long and desperately sought, and created a superior apparatus which was condemned as unworkable by the very patentee upon whose patent defendant relies.

> " * * * The test in such cases is not whether duplication exists but whether duplication produces, not mere duplication of product or function, but a new unitary, additional result, and not the mere aggregate of prior, separate mechanism. The mere elements of the combination are immaterial. In their individual relations they may be old, may be mere duplicates; but the test is not the character of the combining elements, but the result flowing from their being combined."
>
> *Goss Printing-Press Co. v. Scott,* 108 Fed. 253 @ 260 (C.C.A.-3, 1901; cert. den. 183 U.S. 699, 22 S.Ct. 935).

But on the issue of new and unexpected results defendant once again begs the question. Defendant says (p. 8) "Finding No. 8 makes no mention of the function of 'preventing sintering' because a consideration of this effect is not necessary to determine the patentability of claim 23." In other words, when the Court is considering the structural feature of alleged mere multiplication of Bergh's bar 15 it must blind itself to the results achieved thereby, but if the Court considers the new and unexpected result achieved by applicant's apparatus it must ignore all of the structural distinctions between the apparatus of claim 23 and the prior art because those distinctions are minor. This, it is submitted, is not the law.

> " * * * The fact that the changes were so slight is quite irrelevant, so long as they were essential to the purpose, as they were. While the statute grants monopolies only for new structures, and not for new uses, invention is not to be gauged by the necessary physical changes, so long as there are some, but by the directing conception which alone can beget them."
>
> *H. C. White Co. v. Morton E. Converse & Son Co.,* 20 F. (2d) 311 @ 313 (C.C.A.-2, 1927)
>
> " * * * If the thing itself be new, very slight structural changes may be enough to support a patent, when they presuppose a use not discoverable without inventive imagination. We are to judge such devices, not by the mere innovation in their form or material, but by the purpose which dictated them and discovered their function."
>
> *Traitel Marble Co. v. U. T. Hungerford Brass & Copper Co.,* 18 F. (2d) 66 @ 68 (C.C.A.-2, 1927)

Defendant contends, however, that this duplication is an "obvious" expedient and cites Mr. Johansson's so-called admission at App. 48 in support of the contention of "obviousness". But Mr. Johansson's "admission" proves nothing because it was given in response to a hypothetical question which started from the erroneous conclusion upon which the theory of defendant's case is predicated, and the cross-examination upon which defendant relies thus constitutes simply another begging of the question.

Defendant began (App. 48) by asking Mr. Johansson whether a single bar 15 could be placed higher in the Bergh structure, so as to have some regulating effect on the combustion temperature. Mr. Johansson naturally said yes, that if the bar were located in the combustion zone it would have an effect on combustion temperature. But the question posed to Mr. Johansson starts with an assumption which is contrary to fact, namely that there is some suggestion to be found in Bergh—or elsewhere in the prior art — for moving the bar 15 upward. If Bergh had wanted to use the bar 15 to regulate temperature in the combustion zone, why did he not put it there and why did he strenuously oppose the allegedly "obvious" carrying forward of his presumptive suggestion when it was proposed to him?

The next question posed to Mr. Johansson, and which forms the basis of the argument at p. 9 of defendant's brief, *assumed* the obviousness of the very point which Mr. Johansson's answer is said to prove:

> "Q. If you had done that and you had found there was not sufficient regulation, it would have been rather obvious to use a plurality of pipes rather than just one to increase your regulating effect, would it not?"

But whence came the suggestion that even the one "pipe" was to be used for regulating temperature? Certainly not from Sven Wilhelm Bergh!

DEFENDANT'S ARGUMENT CONCERNING THE EDLING REFERENCE

Defendant contends that Edling supplies the concept which plaintiff has demonstrated to be absent from Bergh, namely, "the use of a series of pipes embedded in the combustion zone to prevent sintering." (Defendant's brief p. 10).

The short answer to this would seem to be that if Edling supplies this concept, why has the Patent Office so persistently relied on the untenable premise that the concept is taught by Bergh's bar 15? The Findings of Fact and Conclusions of Law in this case were prepared by counsel for the Commissioner of Patents and a great deal of time and trouble could have been spared both plaintiff and this Court if defendant had chosen to rely on Edling alone for the disclosure of this concept, without raising the red herring issues around the bar 15 and the steaming coils 12 and 13 in Bergh.

Why, then, did defendant not rely on Edling alone for the alleged anticipation of this concept? The answer is that Edling does not show ducts "embedded in the fuel in the shaft and dispersed at intervals transversely of the shaft". Edling shows only the idea of cooling the *walls* of a combustion chamber; but the operative, workable embodiment of this bald idea in a retorting apparatus required that something more be done. And, while in retrospect it may seem that the answer should have been obvious, the evidence shows that it was not. (Dalin's Exhibit 1, p. 7-8)

Merely cooling the *walls* of the combustion chamber would not be sufficient in a practical retorting apparatus. It is necessary to provide "a *network* of ducts * * * *embedded in* the fuel in the shaft and *dispersed at intervals transversely of the shaft* so that the influence of the heat absorbing fluid circulating through them emanates from a number of sources spaced transversely throughout the bed of fuel in the shaft." Defendant completely ignores this limitation of the claim.

Defendant imputes to Mr. Johansson an admission that Edling suggests the embedding of cooling ducts in the combusting fuel in the manner defined in claim 23 of the plaintiff's application. But the cross-examination which leads up to this alleged admission is based not upon the *disclosure* of the Edling patent, but upon claim 4 thereof. That claim is broad enough to read on a network of cooling ducts *embedded* in the fuel, but nowhere does the Edling patent *disclose* such a network. Defendant's counsel, as pointed out hereinbefore, began this phase of the cross examination of Mr. Johansson with hypothetical questions which assumed that Bergh taught a cooling function for his bar 15. (App. 48) Upon this assumption Mr. Johansson was asked how he would modify the Bergh structure in the light of claim 4 of Edling, and he gave the answer quoted at p. 10 of defendant's brief.

But that answer cannot support the defendant's position as to either Bergh or Edling because it is a response to a series of questions which assume as a major premise the very point which Mr. Johansson's answer is alleged to prove. Once again defendant has begged the question.

Finally, defendant has ignored the fact that neither Bergh nor Edling suggest the embedding of at least the lower portion of the retort in the bed of combusting fuel. Instead, defendant has dismissed this limitation of the claim as immaterial but has done so, as pointed out above, on the basis of a distortion of the principles of operation of plaintiff's apparatus.

CONCLUSION

Defendant has not been able to point to any testimony in the record to support the crucial Findings of Fact.

Instead, defendant seeks to sustain these findings by distorting the record or begging the question, ignoring the positive testimony of men whose skill in the art was recognized by the court below.

Since neither the Bergh nor the Edling patent suggests the fully defined major features of claim 23 of the plaintiff's application, the court below should be directed to enter judgment for the plaintiff requiring the Commissioner of Patents to issue Letters Patent in accordance with the prayer of the complaint.

Respectfully submitted,

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